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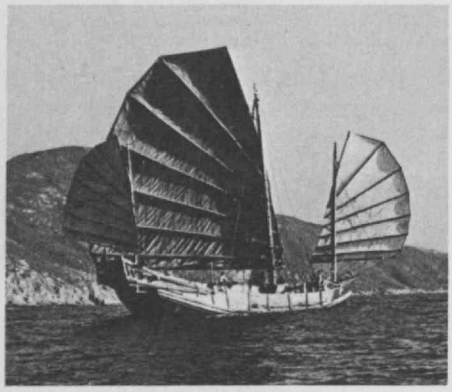

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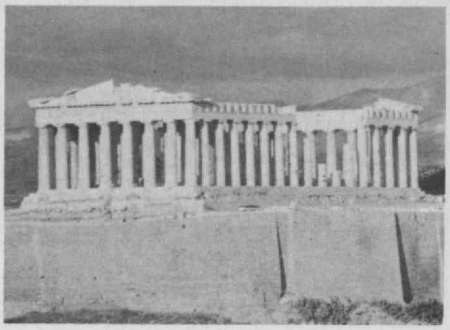

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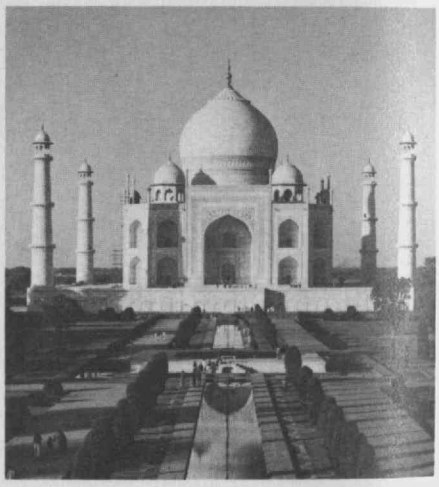

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Preliminary Announcement

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* * *

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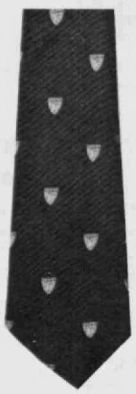

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Technology Review

Edited at the
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Volume 75, Number 3
January, 1973

Articles

The Mind of the Machine 12
Philip Morrison

In an age of computers, the question of why life is different from non-life returns on a new level: What shall we say if machines come to think?

Engineering and Societal "Software"—a New Imperative 20
Gordon S. Brown

Engineers must help the society for which it is conceived understand how new technology is to be used.

The State of State Management 30
Robert C. Casselman

Can a technology-based management system help states recover control over their increasingly complex operations?

Alcohol: a Medicine and a Food 41
Frederic W. Nordsiek

Alcohol is the second most widely used medicine; it is versatile, valuable—and dangerous.

The Profit Side of Pollution Control 49
Terry W. Rothermel

Innovative technology turns out to be but one of the requirements for success in a field that contains more pitfalls than most of its entrepreneurs expect.

Departments

Cover
Cogito ergo sum: I think; therefore I am.
Design by Ralph Coburn; photograph by Marc PoKempner and Robert Lyon

Washington Report 4
Sickle cell anemia as a "health crusade"
Victor Cohn

Special Report 5
Whence comes water for the arid West?
Carl O. Hodge

Special Report 7
Many things are going for cities at sea
Athelstan F. Spilhaus

European Report 9
How the European computer industry is slowly coming of age
Rex Malik

Trend of Affairs 59
Man in the Air, **59**
Life Sciences, **61**
Law, **61**
Bioengineering, **63**
Computers, **65**
Transportation, **66**
Structures, **68**

Book Reviews
Scientists in the Quest for Peace 10
Reviewed by Bernard T. Feld

Investing in Japanese Securities 70
Reviewed by Jerry E. Cook

In the Shadow of Man 72
Reviewed by Janet Kreiling

Puzzle Corner 74
Presenting a cross number puzzle and other diversions
Allan J. Gottlieb

First Line

Those who follow *Technology Review* closely may have noted that the Editors sometimes fail to predict with precision the content of future issues. The point is that we seek always to preserve flexibility, so that timely material may be brought into print promptly—perhaps sooner in *Technology Review* than in many journals with similar frequency. Some authors pay dearly for the editors' assumption of this privilege: for example, Frederic W. Nordsiek has been waiting more than 24 months to see "Alcohol: a Medicine and a Food" in print (and the Editors take this opportunity to express their thanks for his understanding patience).

Recognizing the hazards of the exercise, we now venture to list a few of the authors whose work will be in the *Review* in coming months:

☐ Anne H. Cahn of M.I.T.'s Center for International Studies, on the new Office of Technology Assessment in the U.S. Congress.

☐ William Greenburg of the *Nashville Tennessean* on the economic, human, and environmental issues in strip mining.

☐ Richard Leacock, Visiting Professor of Architecture at M.I.T., on what new technology means to a motion picture photographer.

☐ William E. Lehr of the U.S. Coast Guard Office of Research and Development on oil pollution control.

☐ Henry S. Marcus of the M.I.T. Commodity Transportation Laboratory on the superport controversy.

Robert C. Cowen

Robert C. Cowen has contributed a column entitled "Science Review" to every issue of *Technology Review* since November, 1966—until this one. We announce his departure with regret. Since graduating from M.I.T. in meteorology (S.B. 1949, S.M. 1950), Mr. Cowen has served on the news staff of the *Christian Science Monitor*—for most of that time as its distinguished Science Editor. This fall Mr. Cowen has become the *Monitor*'s Features Editor, and he feels unable to continue as a regular contributor to the Review. We rejoice for him and for the *Monitor*, and we report with gratitude that he remains among the *Review*'s loyal critics as a member of our Advisory Board.—*J.M.*

Sickle Cell Anemia: Another "Crusade"

Washington Report:
Victor Cohn

"Sickle cell anemia" is a vicious blood disease that distorts (or "sickles") the red blood cells, causes pain and weakness and kills many of its victims by age 20. One black American in 400 and a sprinkling of whites, in large part those of Greek or Italian or some black ancestry, develop this or a related sickling disease.

Sickle disease is one of the latest subjects of a series of politically inspired health "crusades" voted by Congress. Such crusades are currently being widely decried by medical scientists. *Science* magazine, for example, reports that "high-ranking individuals in the Department of Health, Education and Welfare and . . . National Institutes of Health," as well as "many observers of the health scene," see them as "a symbol of all they consider irrational in biomedical research planning." Washington newspapers have described the Congress' new "disease-of-the-month club."

American medicine, however, *is* political medicine. The first great health crusade of our time was the anti-polio March of Dimes, which led to vaccines and the end of epidemic poliomyelitis in this country. It was inspired by the polio-stricken President Franklin D. Roosevelt, with the first dimes mailed directly to the White House. The very shape of our medical care is either set by national and state legislators and office-holders in response to the influence and political contributions of organized medicine and health insurors—or left untouched by them.

Leading figures at the vast National Institutes of Health—the government's great medical research complex outside Washington—are in the fore in deploring the present "politicization" of research. But N.I.H. is itself the creature of politically motivated crusades. It grew institute by institute as Congress, for lofty reasons or low ones, ordered attacks on cancer, heart disease, stroke, eye ailments, lung disorders and so on, through the grisly atlas of human pathology.

The Stigma: "Bad Blood," "Just Inferior"

And so it came upon sickle cell anemia.

A few decades ago white science reporters by the score wrote about the "momentous" discovery of Dr. Linus Pauling that sickle cell anemia was a "molecular disease," a discovery which might "someday" lead to a molecular cure. Most of these reporters (including this writer) ignored the disease's current victims.

A number of scientists continued to study the disorder. Clinicians at city hospitals were forced to pay attention to it. But some manuals on children's handicaps failed to mention the problem as late as 1971, and for years black sickle disease doctors like Howard University's Dr. Roland Scott vainly sought meaningful federal help.

Blacks were too long unready, or too uninformed, to face the problem. A 1968 Richmond, Va., survey found that only three out of ten black adults had ever heard of the ailment. The poor and the uneducated knew the least. If they did know about it, they knew it as "bad blood" or just "anemia." There was almost no knowledge of the disease's genetic character or the possibility of preventing it by responsible parenthood. (It is only when two persons carrying the genetic trait have a child that the disease can appear; with each child, there is a one-in-four chance of it.)

Part of the problem was exploitation by white propagandists. A 27-year-old federal sickle disease official remembers that: "I first heard of it when I was in high school in South Carolina. We were in our car, and some white physician or researcher was proposing that blacks were inferior and giving sickle cell anemia as an example."

Dr. Lemuel W. Diggs in Memphis testifies that until recently: "Negroes themselves were opposed to sickle cell research because it was considered a stigma. There were even Negro doctors who didn't want to teach it or learn about it, because it was looked on as a sign of inferiority.

"Most white doctors misdiagnosed it. Negro doctors couldn't afford to care for the patients, because they were on welfare and poor just because of it. When you had sickle cell anemia, you couldn't finish school, you couldn't be employed, you couldn't even afford an aspirin. No wonder the people most involved didn't want to talk about it."

"Washington newspapers have described the Congress' new 'disease-of-the-month club.' American medicine, however, is political medicine."

In early 1970 a few doctors began to call the ailment the nation's "most neglected major health problem"—an exaggeration, perhaps. But there was truth there too, and their statements coincided with the newly rising black consciousness and determination to deal with black problems.

A sickle patient or mother wrote the Department of Health, Education, and Welfare to ask, "What are you doing about this disease?" Undersecretary John G. Venneman asked a 31-year-old fellow named Colbert King—a Howard University graduate, son of a patent office employe and a domestic worker—to find out.

Mr. King began talking to Howard doctors, N.I.H. researchers and H.E.W. medical officials, and at first met mainly the attitude that the disease was a minor one; that "a great deal" of basic research was already being done on blood disorders; and that he and his political bosses should leave well enough alone.

"What Are You Doing . . . ?"

Despite this resistance, some health officials soon agreed that there were major possibilities for new efforts in treatment, public and medical education and genetic counseling. H.E.W. was just then preparing a set of possible new "health initiatives" for President Nixon. On February 12, 1971, Assistant Secretary for Health Dr. Roger O. Egeberg told N.I.H. to "articulate" a "clearly visible" sickle program within five days, and on February 18 the President promised a $6 million start on making this an officially "targeted" disease. During 1967-71, incidentally, $11.8 million had been alloted

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to cystic fibrosis, a largely white disease with some 1,200 new cases a year, hardly more than new cases of sickle cell.

Congress actually voted Mr. Nixon $10 million for the sickle disease start, and this year it added $105 million over the next three years (a sum currently negated by the President's H.E.W. bill veto; Congress is to act again on H.E.W. money early in 1973).

New medical and public interest has in any case been awakened. There were five local sickle disease groups a few years back; now there are between 20 and 30. Black groups have rallied around this health cause, and the director of one sickle organization reports that : "the common concern of this disease brings together different religious, political and educational groups like nothing ever did before." In Winston-Salem, N.C., for one place, the Black Panthers, N.A.A.C.P. and Urban League cooperated—"and who could be more opposed than those three groups?"

There are also many less happy results. What leading black doctors call "unfortunate sensationalism" and "scare campaigns," in all the media have caused unnecessary fear in black communities, and confusion between actual sickle disease and generally benign sickle trait. "Some black people are not being hired, some are not getting insurance, others are paying more for insurance," simply because of unwarranted fear about sickle trait, states Dr. Emerson C. Walden, 1971-72 president of the National Medical Association.

Black groups of all varieties—churches, lodges, clubs, militants like the Panthers—have conducted often over-hasty sickle trait-screening campaigns, without proper medical follow-up or individual counseling. There should be no such screening without careful, individual explanation of at least three points: the possibilities for hope even for sufferers of the disease; the difference between the disease and the mere trait; and the fact that the trait usually becomes of concern only if a man and a woman, both of whom have it, bear children.

The federal government, wisely, is financing programs that will begin sickle trait testing and counseling gradually and carefully in about 20 cities, with plans to educate both counselors and the public.

The First Single-Race Genetic Screening

Such caution will be harder and probably impossible in at least seven states (Virginia, New York, Massachusetts, Illinois, Georgia, Louisiana, Kentucky) and in the District of Columbia if they enforce a spate of new compulsory sickle trait screening laws. These were introduced in the last few years by black legislators eager to "do something" about the disease, and passed with almost no public announcement or debate and almost no consultation with sickle disease doctors.

These laws require, or at a doctor's or health officer's discretion may require, that black children or adults be screened for sickle trait whether they like it or not. The laws in most cases are worded so as to limit the tests entirely or largely to blacks.

They thus become the country's first genetic screening mandate, and the first health screening mandate aimed at a single race. The implications are enormous. Dr. James Bowman, director of laboratories at the University of Chicago Medical School, calls the laws the same kind of racist "eugenics" legislation that "led to the final solution in Nazi Germany."

The laws are now being opposed by sickle specialists at Howard and Meharry Universities, by the National Medical Association, by some 100 health and civic leaders who attended a June, 1972, sickle conference at Meharry, by a growing National Association for Sickle Cell Disease, by a genetic screening committee of the Hastings (N.Y.) Institute of Society, Ethics and Life Sciences, and by federal sickle program officials and their medical advisers.

A health crusade, in other words, has its good points and its bad ones.

We obviously need more logical health planning. The challenge is to combine a health crusade's democratic expression and spontaneity with the funds, will and intelligence to attack a host of far worse health problems, than sickle disease, both black and white.

Victor Cohn, formerly Science Editor of the Washington Post, *is now concentrating on major science-oriented reporting assignments for that paper.*

Water: Alarums and Diversions

Carle O. Hodge

Although they hardly constitute a consensus, multiplying numbers of scientists and engineers are questioning what once was regarded as an unassailable tenet in the American West: that long-distance diversions of water are prerequisite to progress—if not survival.

Now, a judgment has been reached by the Committee on Arid Lands (C.O.A.L.) of the American Association for the Advancement of Science. C.O.A.L. believes that the fact they are technologically achievable and might even be useful are not justification enough for large-scale water importations. Whether or not one agrees, he cannot fault the committee for having acted in haste. Almost 60 years have ensued since the occurrence of what headline writers, with their customary restraint, called "the Owens Valley war."

In 1913, Southern California began its monumental aquations by reaching out 238 miles to divest the Owens Valley, to the lee of the Sierra Nevada, of most of its water. Later, the valley farmers, who considered themselves pillaged, responded by dynamiting the new aqueduct. That great concrete conduit soon was restored, of course; the thirst of the Los Angeles area and the irrigable in-

land barely had started to manifest itself. The next step was to tap the Colorado River, still more distant. Completed the year before Pearl Harbor, the Boulder Canyon Project sent river water coursing across the desert to the coastal cities 240 miles away and to the Imperial and Coachella valleys.

Again, there had been rancor. Arizona, covetous of its share of the Colorado, marshalled National Guardsmen in a comic-opera bluff at the dam site. Yet the militiamen, like the Owens Valley vigilantes, merely were acting out a charade, a symbolic show-down between (depending upon where one stood geographically) the good guys and the bad guys.

To the rest of the nation, without whose taxes none of this could have unfolded, these nonetheless must have seemed no more than local disputations—incarnations of that Hollywood cliché, the feud at the waterhole. Nor did many in those days of a residual frontier ethic bother to ponder the subtle if immutable effect that their works might have on the environment, for these events became history at a time when the land still appeared limitless. Only ecologists knew about ecology; water belonged to those who took it (regardless of whether they needed it all)—and the skies were not smoggy all day.

Cotton and Alfalfa in Manhattan?

Since the second World War the dreams of the planners, mothered, they say, by the necessities of the future, have become increasingly inventive. The most brobdingnagian of their concepts, so far, has been the North American Water and Power Alliance Project, or N.A.W.A.P.A., which would transport water from Alaska and the Yukon as far south as Mexico and, coincidentally, construct a ship canal from British Columbia to Lake Superior. The cost, it was estimated, might exceed 100 billion 1964 dollars, 1964 being the year that the notion was conceived by Ralph M. Parsons, a California engineering firm. In view of the price and the possessiveness of Canadians, nothing really has happened with N.A.W.A.P.A.

Texans, not to be outdone, proposed to convey Mississippi River water across Louisiana and Texas to their own semi-arid high plains around Lubbock. Voters in the state, apparently more out of economic than ecological considerations, rejected a 1969 bond issue that would have opened the way, but the plan's advocates still harbor a hope that federal funding may make it a reality.

As the various undertakings evolved on paper, objections to them grew among conservationists, and more and more researchers expressed reservations. At the outset, it was the biologists who were worried about habitat destruction and the impact of diversions on biomes. Some social scientists voiced suspicions, and then they were joined by colleagues from an array of disciplines.

Arizona has over-drawn its water account for years, pumping more from the ground than nature replenishes, and skeptics have pointed out that while agriculture accounts for less than a tenth of the personal income in the state, farmers use nine-tenths of its water supply to flood their fields. Moreover, the largest acreages are planted in relatively low-value livestock feeds and in cotton, the latter a crop that other farmers have been paid many millions of dollars not to grow. The logic of this was assessed by the Committee on Water of the National Research Council. The committee concluded that "irrigated agriculture in Arizona is no more necessary, in an absolute sense, than agriculture in the middle of New York City," and intimated that it might be less expensive to buy out the farmlands, and retire them, rather than bring water from ever greater distances.

Can the Colorado River Defy the Courts?

Other scientists have asked about the amount of water that westerners use and, in the longer run, the amount ultimately available to them. For one, geographer Gilbert White of the University of Colorado, suggested that they might be more frugal with what they do have (Nevadans, for instance, use twice as much water as New Yorkers), recycle their supply, line leaky irrigation canals, and perhaps even pay more for water.

Regardless of what they might pay, the supply obviously is finite. It may be more limited than thought, according to the tree-ring researchers at the University of Arizona who have studied climatic changes as indicated by the varying annual growth rings in conifers. They found that the time period, early in this century, commonly used for predicting flows of the Colorado River, was in fact the rainiest period in at least 400 years. What this implied was that the Colorado, undeniably erratic, might well yield far less water than the courts and the government have allocated.

At the same institution, two economists argued that "if the problem is to obtain maximum economic growth, water must generate benefits in excess of the costs of transporting and distributing it." A local newspaper insisted editorially that the economists be fired.

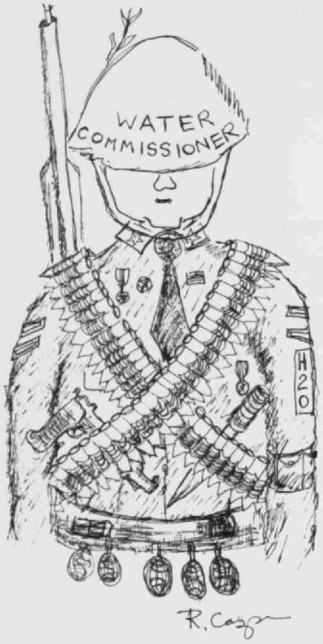
The gist, then, is this: opponents of large-scale diversions contend that the West should adapt to existing water sources where they exist; proponents, on the other hand, reply that if the region is to accommodate an inexorably expanding population, more water must be siphoned to the cities. The proponents, it would appear, are winning.

Although the National Research Council study, which Dr. White headed, generally avoided specific suggestions, it did offer one—that there be "a systematic canvass" of "the myriad alternatives" to still more vast water networks. A few months after that report was released, in 1968, Congress approved the Central Arizona Project to channel Colorado River water into the Phoenix and Tucson areas.

By then, too, the most ambitious of the present projects was taking shape. Ultimately the California Water Plan will, among other things, move Northern California water 444 miles to the endlessly proliferating spigots of Southern California. More than $2.3 billion has been spent; if Ralph Nader is to be believed, the final cost could be $11 billion. Most of the main components to be constructed were essentially completed at the end of 1972, although problems persisted. Not the least of these was the so-called "peripheral canal."

The idea, originally, was to pick up water from the Sacramento River, route it through the canal around the Sacramento-San Joaquin Delta and finally funnel it into the south-bound California Aquaduct. Much to the chagrin of the Bureau of Reclamation, U.S. Department of the Interior, however, a report from the U.S. Geological Survey, same department, cautioned that this would turn San Francisco Bay into "a dead lake." The bay needs the sedimentary nutrients and the scouring that the Sacramento provides, the U.S.G.S. said. As a result, the State Board of Water Quality ordered that much of the flow be left as it is. The ruling has left the State Department of Water Resources in a dilemma: where will it get the additional water?

Meanwhile, back across the Colorado, construction on the Central Arizona Project was supposed to have started in 1972, but it didn't. Officials believe the delay to be routine and temporary, but their antagonists seized upon it as a glimmer of victory, and the quarrels over environmental protection continue unabated. From the standpoint of the conservationists, the most telling argument well may be that the project undeniably will erase some of the state's rare stream-side vegetation—and with it the habitats of several species of endangered



"Opponents of large-scale diversions contend that the West should adapt to existing water sources . . .; proponents reply that if the region is to accommodate an inexorably expanding population, more water must be siphoned to the cities."

birds.

Even if the Central Arizona Project were not finished, an unlikely eventuality, one of its features is becoming an indelible fact, and here there is a certain irony. When the project first was put forth, it was to include two dams in the Grand Canyon, structures to provide hydropower for electrical generation. Part of the energy would have been harnessed to pump water from the Colorado into Central Arizona, the rest sold to pay for the project. Under pressure from conservationists, though, the Bureau of Reclamation abandoned the Grand Canyon dams. Still, energy had to be found for pumping the water, and to do that a coal-fired power plant is being erected in northern Arizona, just beneath the Utah line. The coal is strip-mined from the Navajo and Hopi Indian Reservations, and the plant is not expected to enhance the pristine desert air. But that, as they say, is another story.

Carle O. Hodge is Research Coordinator at the Environmental Research Laboratory of the University of Arizona.

Engineering Afloat: Toward a Sea City

Athelstan Spilhaus

The most bountiful grant of the sea is space—space for man to extend his living to the other three-quarters of the earth, space close to the coasts where people crowd, space close to the great cities of the world and the principal terminals of world trade. Today 53 per cent of the people in the U.S. live within 50 miles of the coast; projections say that by 2000 80 per cent of the U.S. population will live in that area.

The area of land on earth is constant—less than one-third of the earth's surface. Land is not boundless, as man once thought it to be when there were fewer of us. So it is that a battle over land use is now going on all over the U.S.; and it is most intensely fought in the arena of the coastlines and oceans.

Coastlines are a constant length; they are one-dimensional. Yet man and his activities are three-dimensional. So far, responding to growing demand, man has broadened his use of the coastline by extending it inward with channels, canals, and harbors. He has done little to change its length by extending it out to sea.

Indeed, most of today's coastal zone management plans concentrate on preserving the coasts as natural resources, and surely one proper concern is for recreational use of beach and harbor. But these plans do not provide adequate positive encouragement for renovating the coastline to increase human uses of its resources. We need to supplement present efforts with a *vigorous* national program of sea use, to move such activities as we can—that are presently cluttering up the shoreline—out to sea.

An inventive, imaginative, and adventurous ocean engineering program could multiply our living space by properly using the sea.

The bounds of land are only the bounds of men's minds limiting their imagination. Man's use of land should not be bounded by seashores. We come inescapably to the fact that any land use plan must also be a sea use plan, that land use must involve sea use.

Returning to the Sea

This is not such a revolutionary idea. Man has indeed been returning to the sea for thousands upon thousands of years.

The first light that warned sailors of dangerous shoals and rocks or guided them into protective harbors safe from storms was probably a fire on a cape. Today such lights are carried far to sea by lightships. Man first found oil naturally seeping out on land, and he sucked up naphtha with sponges from the edge of the sea. He first drilled for oil on land, but soon he did so from fixed platforms and later floating rigs. And now we see moving under the sea not only prospect drilling but also production and storage.

Harbors have traditionally been at the meeting point of sea, air, and land—at once a place of refuge and a point where tides, waves, winds, and shoals combine to make a potentially dangerous course for navigation. As ships became larger and larger these dangerous harbors became inadequate, so we now fill tankers from buoys out at sea, and in the North Sea we are building artificial islands as harbors for large vessels. Harbors, too, are striding out to sea.

Our energy production facilities must soon follow. The East Coast needs eight new oil refineries by 1975, and the U.S. needs 78 new refineries, each costing $150 million and requiring three years to build, by 1980. Yet people and governments are banning refineries from many of our coastlines, and in other places the environmental restrictions on refineries make it impossible for the petroleum industry to economically supply the energy we need from onshore sites.

For these reasons no new refineries are on the drawing boards, and the president of a large oil company says no company will build refineries here; land use and environmental restrictions will force them to build overseas instead. The jobs that go with them will also be exported—and the pollution associated with them will simply be moved to someone else's back yard.

Would it not be better to retain these refineries and the jobs and wealth that go with them and to contain the pollution associated with them? We can do this by good engineering—and by considering imaginatively the proper use of the sea.

Far from curtailing our energy production, we must vigorously increase the amount of energy we produce so that we may invest some of this energy in producing new energy sources and in moderating their environmental impact.

Nuclear power is the most important investment we can make. Yet it, too, has a gun behind its back. People are choosing to live near the ocean, and power plants must be there, too—to be near the

consumer and the huge amounts of water required for cooling. But people concerned with environmental issues are now preventing these plants from being built. Can we have our cape and heat it too by using the sea?

Harbors are another urgent need in connection with the same problem—energy, the fundamental currency of civilization. The cheapest way of transporting oil is by tanker; the larger the tanker, the more economical it is and the more safe it should be made from spillage and from collision. The larger the tanker, the more feasible it is to spend the money to make it free from the possibility of collisions and oil spills.

But there is not a single harbor in the United States that can accept the 500,000-ton tankers that are now being built. To adopt the expedient of offloading these tankers into small barges is the wrong way to go; this simply increases the cost and the danger of spills and pollution. We must take the harbor out to sea and contain the oil spills.

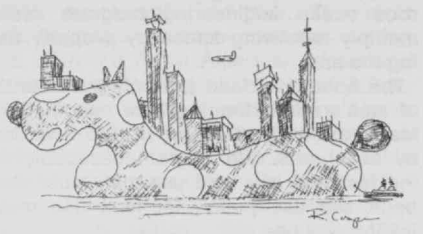
Proper engineering can completely protect shore and adjacent waters from pollution and spills from a harbor out at sea. Submarine tankers are an imaginative idea, but they have been ruled out in the past because of the complications of offloading them. However, if they can offload underwater into submerged pipelines, they may become feasible.

From One Enterprise to a Conglomerate

Fishing, for U.S. fishing vessels, has only one hope—to take a technological overleap. To justify this cost, fishing vessels must spend more time at sea and less in port. They must be coupled to fish factories. One can imagine these fish factories and processing plants at sea separating seafood wastes from food parts and even piping the food fish into shore through pipelines. The wastes, properly treated, may be used as nutrients for fish farms associated with these complexes. Thus, aquaculture might grow around sea cities just as agriculture surrounds our land cities.

Organic wastes from the land could be piped out to waste treatment plants at sea, there to be used for aquaculture purposes. Low-grade heat from generating stations at sea could also be used in aquaculture to provide optimum conditions for fish farming. The same complex may also contain plants to extract minerals from the sea, claiming magnesium from seawater or using mined phosphate rock. One of the great costs of extracting things from seawater is the volume of water which must be pumped, but if you plan carefully you may be able to use the same pumps and water for several purposes—extracting minerals, deriving fresh water, cooling power plants, even air conditioning.

Airports present somewhat the same land-use problem as power plants: they need to be near where people are, yet they then occupy huge tracts of land that people constantly need for other purposes. Traffic congestion on the ground to and from the center of the city reduces the airports' usefulness, and noise is so unwelcome near population centers that aircraft now are under restrictions relating to the use of power on take-off and landing that either increase the hazard of flying or increase the power requirements—and hence the cost—of aircraft. Airports could move out and join the complex at sea.



"An inventive, imaginative, and adventurous ocean engineering program could multiply our living space by properly using the sea."

Enter: the Sea City

Wherever it is, a city must start with a purpose. Then people come to work toward that purpose, and thus the city grows. The multiple uses I have outlined constitute the real purpose of a sea city; we are not proposing a bedroom city or a city in search of its mission. With airports and harbors, hotels for travelers would be necessary as would housing for freight handlers, the airport workers, and harbor workers. Hotels at airports on land have to be insulated from the aircraft noise. What better insulator could there be than seawater? And with hotel accommodations in the huge floats or pylons beneath the sea surface, travelers would truly have an "ocean view"—from below!

There would be recreational facilities—marinas and submarinas (underwater parks) which would take the crowded marinas away from the shore. Thus the shore could remain for people without boats to use, and boatmen would have far easier and safer access to deep water.

As all readers will recognize, this vision is simply the result of putting together many well known suggestions. Indeed, actual engineering works are going on in these directions. An offshore nuclear plant is now planned to be floated three miles off the New Jersey coast, and an imaginative model has been built for a floating city to be associated with the bicentennial celebrations in Hawaii. Honolulu's airport is to be multiplied in capacity by extending a runway on a reef offshore.

But other nations are ahead of us. The Japanese already have great plans for a floating city. Northern European nations are planning—some even building—a considerable number of offshore harbor and industrial islands in the North Sea. All of these steps are good ones, and they can contribute the experience they represent to the complexes we will put together in the future.

How can we in the U.S. take a step jump and put the whole system together instead of whittling piecemeal and having to solve all the public policy questions and the endless national and international debates over and over again for each step we take seaward?

Sea Use as a National Goal

It is probably not economical for an individual activity—for example, oil refining—to move out to sea by itself as a single activity and in the short time scale available to meet the urgent energy demands. But if we join uses in a systems concept with other activities, moving out to sea is feasible. The total cost of such a sea complex would be less than the sum of the individual costs of the components, and the total system would add more in social value and in environmental and economic gains our society needs than the sum of the social goods of the individual components of the system.

How to do it? Public policy is the key. There must be new thinking and new policies in government, industry, and the universities—new because we must recognize that the dimensions of the task for the proper use of the sea are very large indeed. The dimensions are so great that government's role must be comparable with that in such earlier national programs as those in space and in atomic energy.

The effort required of industry is probably larger, too, than even the largest of our corporations would undertake alone. And the basic understandings in science and technology that we will need and that our universities can provide are beyond the power of any single institution to provide.

The size of the job requires that the government establish the sea-use project as a national goal (as was done in atomic energy and in space) on a time scale that is realistically long enough to achieve its goal yet realistically short enough to meet the urgency.

The size of the effort necessary by industry is such that we must abandon our old assumptions about the badness of large size, monopolies, and cartels. For we must have associations of a number of our very largest industrial concerns to achieve the building of a single sea city. Universities will likewise need to integrate many separate pieces. And one single institution or consortium will be needed to bring together, to correlate, and to aim all the ocean engineering developments toward the synergism necessary for the combined complex.

Jefferson, in 1801, wrote about the ocean, "Nature . . . has made it common to all for the purposes to which it is fitted." How about a Jefferson Laboratory dedicated to this project viewed in its holistic sense?

Dr. Spilhaus, now a Fellow of the Woodrow Wilson International Center for Scholars, studied meteorology at M.I.T. and has had a distinguished career at the Woods Hole Oceanographic Institution, New York University, the University of Minnesota, and the Franklin Institute in Philadelphia. This essay is adapted from his presentation as the first annual Sea Grant Lecturer at M.I.T. this fall.

Towards A European Computer Industry?

European Report:
Rex Malik

Both Herman Kahn and Jean Jacques Servan Schreiber—the first in *The Year 2000,* the second in *The American Challenge*—agree on one proposition.

Unless present trends change, the world of the future—and not too distant, at that—will contain not just the sharply divided rich and poor but a three-way split of economic performers: the very rich—America, Japan, Sweden; the very poor—most of the present underdeveloped countries; and the not-too-rich and not-too-poor in the middle—a group which seems to contain most of the present nations of Europe.

If you accept this line of argument, what then follows is effectively a new colonial relationship between Europe as the colony and the U.S. and Japan as the colonizer. This is not something most Europeans find easy to take.

The idea that Europe is faced with colonization is not, of course, new. Indeed, the notion that economic weakness was inevitable unless something was done to unite Europe had much to do with the setting up (and the continuing expansion) of the European Economic Community (E.E.C.). But that is not enough. Once you set off down the road of economic union, industrial policy must become interventionist to overcome local interests and thus assist the growth of community-wide institutions, industries, and markets. Such intervention is particularly important in the field of research and development, for outside assistance from public funds here is precisely the sort of carrot which will encourage organizations to get together on the basic issues which affect future development.

Talk is easy, but doing it is different. For no community-wide European organization or effort starts from scratch. There is some sort of European identity in the private sector in almost every advanced field; many such corporate identities are well entrenched, are large (if not usually large enough), and have been in their line of business—sometimes leading it—for a very long time. But Europe's industrial giants do not often speak the same language; each has its own methods of working, each has unique and individual product lines, and each may well be bound by laws, customs, rules, and practices which differ from those followed by counterparts or competitors.

Mounting a Challenge to I.B.M.

The problem can be illustrated by looking at how the European computer business is meeting the challenge of I.B.M. According to O.E.C.D. figures, Europe accounts for some 32 per cent of the world computer market; but at the last count I.B.M. had over 50 per cent of the European market while the European companies between them had generally less than a third. (Besides I.B.M., they also have to face Univac, Honeywell, Burroughs, N.C.R.,C.D.C., and Digital Equipment.) Yet ten years or so ago, 80 per cent of the European market was in European hands.

If you go to the wider stage and take all the European computer companies together—I.C.L., Compagnie Internationale Informatique, Philips, Siemens, and Nixdorf-Telefunken—their share of the world computer market runs to a little over 7 per cent.

To survive, one needs survival policies.

For most of the 1960s, almost everywhere in Europe, the concern was with mergers, which are one method of rationalizing industry. In Germany, Zuse was taken over by Siemens: in France, government aid made possible the amalgamation of a number of interests into C.I.I.; in Britain, I.C.L. arose from a merger of I.C.T. and the general-purpose computer activities of English Electric—activities themselves already drawn together in part by mergers of a number of computer manufacturers.

Meanwhile, European governments were beginning to realize that a strong, indigenous European computer industry could not be achieved without rationalization across national frontiers. For the weakness of inter-European computing trade had already become apparent at least among the European-owned companies who even today still do 90 per cent of their business in Europe, largely in their own countries. At first the chosen route was that of extending the established internal policy—mergers—to the international level. Indeed, the first trans-European merger discussions go back to 1961.

But inability to come to agreements on mergers has perpetuated the weaknesses of smallish companies operating in small, national markets; internationalization remains elusive. Today there is still no European-owned company which has anywhere near 5 per cent of the world's market, the minimum figure that the E.E.C. Commission considers enough to ensure a company's survival.

Coordination, Protection, and Cooperation

If the merger route does not seem to work, are there not other means that could be chosen for strengthening European firms against incursions from overseas? There are three, and all are being followed concurrently.

First, there is the route of coordination—persuading manufacturers to agree on a common range of systems and support services, each to retain his independence in some areas but, in the general-purpose computer area, to work to a common program supported by government research and development subsidies. An agreement on these lines has been reached, after long discussions, between Siemens and C.I.I.; it has recently been complicated by the last-minute addition of Philips of Holland, but currently its reality is attested by a new range of computers now being developed.

Next, there are a large number of protective measures that can be taken to reserve parts of any particular market to locally owned and controlled companies. The first market area subject to such reservation is obviously that of the governments themselves, with computers in use in defense, administration, communications, air transport (most of the major airlines have strong links with governments), and education, and in managing electricity and gas generation and distribution and nuclear power. The methods used are single-tender ordering, price differentials, budget limitations—either you order from a European manufacturer or you do not order at all—and the like.

The situation is complicated by the existence of American manufacturers' subsidiaries—often quite large—on the spot. I.B.M. World Trade is still the largest European-sited manufacturer, and Sperry Rand (Univac), Burroughs, N.C.R., and Honeywell are all substantial employers with a considerable stake in Europe. If local industries are to be supported they obviously have to get something; but they do not receive business even approaching what their size on the ground would lead one to expect.

There comes a point where purchase limitations can create a situation where their very success is their own justification, and this point in fact has already been reached in the U.K. It works like this: You restrict a particular field to the machines of one manufacturer. Eventually, you discard all the older machines installed before the policy took effect, so you no longer have systems from six manufacturers, nor are you running a large number of incompatible programs each doing the same thing. You have standardized across a sector of government and reduced your systems support costs, and you are in a very strong customer position. (You are also locked in, but as you support the manufacturer with research and development funds, that is not in practice such a difficult situation).

The third alternative to merger is a set of intra-European measures which governments and industries between them can take to increase their own strength. They can be applied at either of two levels.

At one level, there is what companies can do in common to influence the market without requiring the full paraphenalia of mergers, joint ranges, and the like. Thus two years ago I.C.L., C.I.I., and C.D.C. came together to create Multinational Data S.A., a company whose job is to develop data-processing standards so that the companies will produce mutually compatible products. The first set to be published will appear this autumn and deal with such things as the languages ALGOL/60 and FORTRAN. Future standards will deal, too, with hardware—the compatability of such things as magnetic tape units, for example.

At the more formal government-to-government level, the lead has been taken by the E.E.C. Commission. The plan is basically to persuade the governments concerned to work out together how the industry can be restructured. To do this, of course, demands some pretty deep digging into what Europe actually has and can provide. The Commission has therefore initiated many curveys and studies,

"Once you set off down the road of economic union, industrial policy must become interventionist to overcome local interests and assist the growth of community-wide institutions, industries, and markets."

among them a study of compilers (the "dictionaries" whereby machines understand programming languages) and one concerned with identifying development programs which are multinational in nature. Such international cooperation conflicts with the habits of governments to support local industry without much reference to the moves being made by other governments; but these habits are beginning to weaken as governments realize the long-term implications of a unified European industry—including even a common European purchasing policy.

The Commission is also approaching rationalization from the user's end. A study of computer-aided design for the aircraft industry has been done, and the Commission is due shortly to start one on computing in medicine. It is looking, too, at computer training—including that of teachers—and is involved in attempts to set up common educational standards and syllabi. It has also become involved in that major cause of concern, data banks and privacy, and some work has been done to disseminate information on privacy laws.

More focus is needed than can be provided by a lot of civil servants sitting in Brussels and by projects sited in and largely used by one country. So attempts are being made to create an international software center, a sort of European library *cum* exchange research center. And early next year a major data transmission project will begin—the creation of an experimental network to link publicly financed research laboratories in Germany, Italy, Switzerland, France, and the U.K.

The Important Is Not the Dramatic

Individually, none of this E.E.C. work may sound very exciting. And it is, as yet, not very noticeable, for so far only some $20 million has been allotted. However, the national governments between them are already spending something around $250 million a year on support policies (and this does not include preferential measures taken on behalf of companies owned by their respective nationals). The great spending years are obviously to come.

It is, however, the dramatic that we have to eschew. In the early days—and those are not so far away, about five to six years ago—the concentration was on such projects as the creation of a large European computer. The monies voted to study that particular project eventually helped to narrow the area down to what really needed doing; Multinational Data S.A. is a direct result.

Considering the problems, we have done well to get this far this quickly. Indeed, the major effect is an intangible, yet it is something which will have I suspect a profound impact on Europe's future. The governments concerned are beginning to realize the sort of time scale in which they have to think and plan if they are to obtain worthwhile results, and they are beginning to understand the costs of doing so.

We had a good indication of this in the U.K. earlier this summer. As it awarded a large airport/air traffic control automation contract, the central computing part of which was for I.B.M. 9020D's, the government also stated that it was placing research and development contracts with "local industry" (the phraseology was kept a little vague, indicating probably that some moves would be made in and with continental Europe) for systems to replace by the middle 1980s the one now due to go in. That kind of 10-year planning is a large step forward, when one remembers the two-to-three-years-in-advance "look forwards" the government used to go in for not so long ago.

Rex Malik is a British science writer who follows European affairs through which technology affects economics and national policy.

Pugwash: Scientists in High Politics

Book Review:
Bernard T. Feld
Professor of Physics, M.I.T.

Scientists in the Quest for Peace:
A History of the Pugwash Conferences
by Joseph Rotblat
M.I.T. Press, Cambridge, 1972, xxii + 399 pp., $12.50

"Pugwash is a union of scientists who are concerned about the relation between science and society. Its purpose is not to promote the interest of scientists, nor to fight for the status of science, to discuss salaries or funds for research. Instead we are alarmed by the fact that science, which for so long was thought to confer nothing but blessings to mankind, today also displays a different aspect. It can be exploited—and is exploited—also for destruction and repression. Something has gone wrong, seriously wrong, either with science, or society, or with the relations between science and society. The most serious problem facing mankind today is how science can be used, not for warfare, but for the welfare of the human race."

In these words, Professor Hannes Alfvén, Nobel Laureate in Physics for 1970 and President of the Pugwash Conferences on Science and World Affairs, defines the Pugwash phenomenon in his Foreword to Professor Joseph Rotblat's History of the Pugwash Conferences.

Rotblat has written a bare-bones, dry, unemotional, completely factual history of the 21 conferences that took place between their inception—in the little Nova Scotian town of Pugwash in July, 1957—through the Conference held in Sinaia, Romania, in August, 1971. There are brief descriptions of the settings and programs of each Conference; the statements issued at their conclusions; lists of participants, observers, student-aides; distributions of participants according to geography, profession, age, etc. In short, a very complete and accurate account that will be invaluable to sociologists and historians of science and politics.

As the author notes in his extremely clear (and strangely moving) preface: "I have described what Pugwash has done but not what it has achieved. The reason is that achievement is often a matter of judgement rather than of fact. In the highly complex problems discussed in Pugwash, where so many diverse factors interact, it is impossible to measure the influence exerted by any single factor. For this reason we cannot determine with scientific precision the effect which Pugwash has had on world security."

A Story Still To Be Told

However, this reviewer does not suffer from the self-imposed inhibitions of Professor Rotblat. Having participated actively since 1958, I find that Pugwash continues to represent for me the most effective outlet for the passions so aptly summed up by Professor Alfvén in the paragraph quoted at the beginning. To me, the accomplishments, however small, and the near-accomplishments represent the excitement of Pugwash. And the people who participated, the scientists, great and not-so-great, are an integral part of the story.

This is a story that still needs to be told. I hope it will be told soon, while most of the actors are still around. (Alas, some of the stars are already extinguished.) Obviously, I cannot tell even a small part of it here; but perhaps a few examples will help to make my point.

Take the part of Pugwash in the achievement of the Test Ban Treaty of 1963. The dangers resulting from nuclear weapons testing have been on the agenda of every Pugwash Conference since the start. For many years, in fact, these issues served as the litmus test of the viability of the original idea of Bertrand Russell, Albert Einstein, and the other nine signers of the manifesto that has served as the movement's charter: that, confronting such life-or-death issues, scientists would be able to put aside their ideological and political blinders and would "remember your humanity, and forget the rest."

One of the first achievements was an agreement on the extent of the radioactive contamination in the atmosphere that had resulted from nuclear weapons testing, and the degree to which such contamination represented a hazard to various forms of life. The ability to agree on all the important technical aspects of these questions provided the strongest encouragement for the continuation of the Pugwash discussions and their extension into more politically sensitive areas.

The problems associated with the verification of a test ban treaty were es-

pecially difficult, since the early discussions were taking place in a period (1957-63) when cold-war tensions were only just starting to abate, a period when the memories of Joseph Stalin and Joseph McCarthy were still sharp and their imprints on the intellectual climates of their respective countries still strongly felt. In this period, the Pugwash discussions on inspection problems were taking place in parallel with the official discussions; indeed, they involved the same scientists on both sides, but with the difference that there were no official inhibitions on either the subject matter or the scope of the Pugwash discussions.

The effect was that Pugwash served as a sort of escape valve, where misunderstandings, accusations of trickery or double dealing (as when the "big-hole" idea for evading detection of clandestine tests was suddenly and inexplicably introduced into the official proceedings by the U.S. negotiators; or when a year-long test moratorium was broken without warning, with a massive series of Russian tests) could be thrashed out; tempers could flare and then cool; ideas for accommodation and compromise could be tried out, modified, discarded or adopted, all in a neutral and friendly atmosphere of meetings between peers. I am convinced that these private discussions kept the test ban alive; that it could otherwise not have survived the U-2 incident, the Kennedy-Khrushchev confrontation in Berlin, or the Cuban missile crisis, to mention just a few of the pitfalls.

The Many Uses of Pugwash

Right up to the wire, even after most differences had been ironed out on the official level, the Pugwash forum was still a useful one. Unfortunately, despite the best official and unofficial efforts, there was in the end no agreement on the verification procedures that would have made possible a ban on underground nuclear testing—to go with the prohibition that was finally agreed upon of testing in the atmosphere, in the oceans, and in outer space. But Pugwash certainly tried: first, by developing, at the London Conference in September, 1962, a scheme for the emplacement of "black box" automated seismic stations on Soviet and American territories—a proposal jointly made by a group of Russian and American participants; and then, when the principle of limited but mandatory on-site inspections having been agreed upon but with the negotiations still oceans apart on the number to be permitted, a small, private Pugwash meeting in London, in March, 1963, managed to narrow the gap to where we were convinced a compromise solution should have been possible.

(Looking back, it is even less explicable now than it was then that our politicians could not have arrived at the obvious compromise between the three on-site inspections finally offered by the Russians and the seven we finally insisted upon. But, in the end, the Joint Chiefs prevailed on both sides, and the Test Ban Treaty of 1963 has been con-

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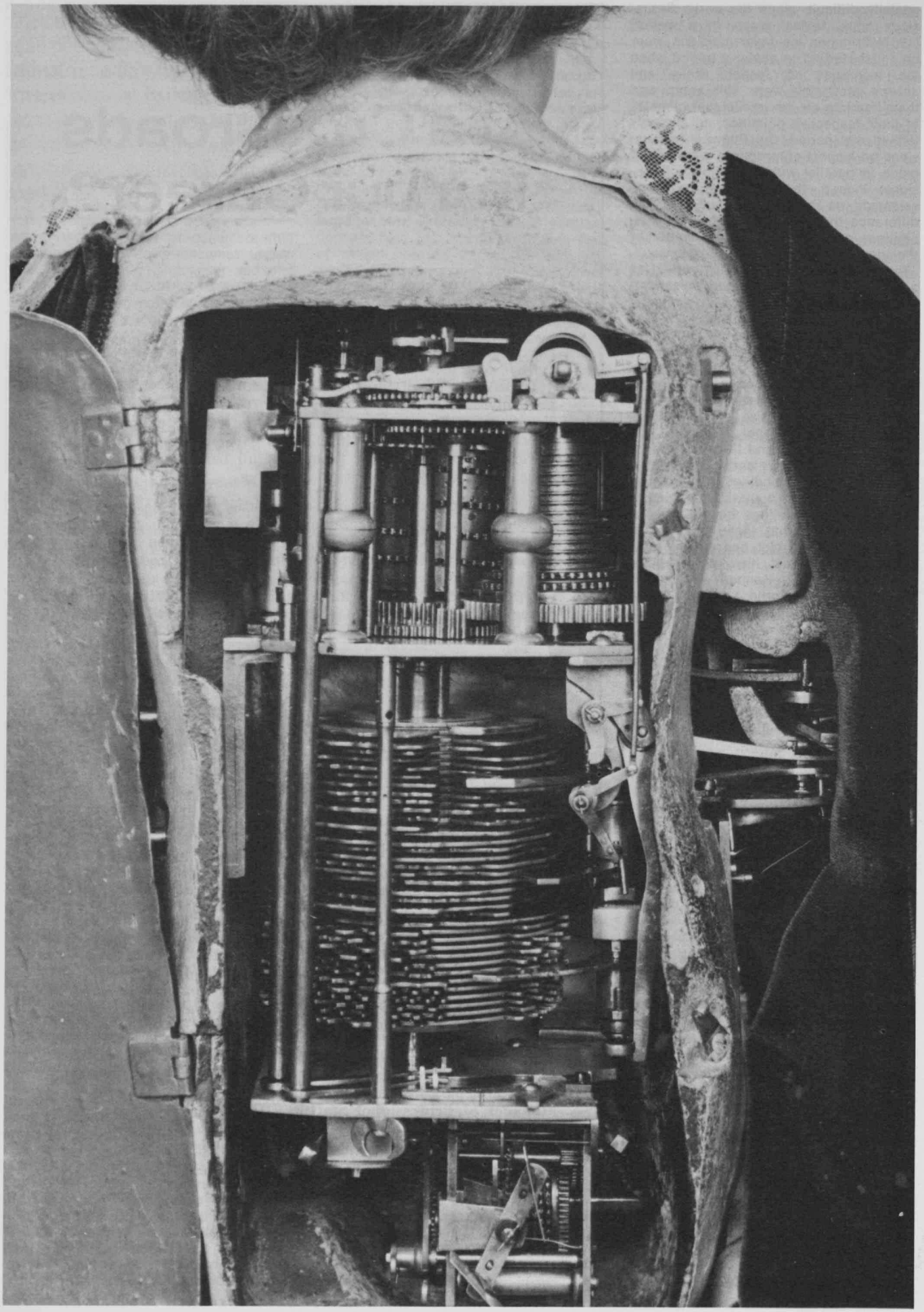

Philip Morrison
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The Mind of the Machine

With each age of seemingly magical machines that simulate aspects of life, the question of why life is different from non-life returns on a new level. The ancients' simulations of purposeful motion were magic, until man came to understand that life meant more than the ability to move. In an age of computers, what shall we say if machines come to think?

On the wall of my office is a world map, computer-plotted and therefore not as beautiful as a draftsman would manage. On it are bold outlines, in eight or ten thousand dots, of the huge plates that make up the crust of the earth, which, when they spread apart or touch together or ride one over the other, generate most, perhaps nearly all, substantial earthquakes. The map embodies that realization, for its dotted outlines of plates were made by thousands of earthquake foci.

The curious part is this: the seismologists responsible for the map say, somewhat apologetically, that since their own recordings of earthquakes were in one standard format which could easily be told to the machine so as to locate the dots on the map, they could use only their own data. They knew, to be sure, that seismology is much older than this decade, but the effort to try to connect the past to a standard coordinate system, to put in readable form into their computer the vast and diverse literature from 1840 until 1961 —all this was beyond them. So they dropped out all reference to the science before 1961, and used only the earthquakes their own world-wide network of detectors recorded from 1961 to 1967. That, however, was as many as all the earthquakes recorded up to that time. They lost a factor of two, which is not much statistically; they gained the advantage of not having to read and interpret all those obscure German journals.

This is a parable for the computer. Like all parables, it has an internal tension: it gives something to the enemies and to the friends of the computer alike. For the friends it is patent that this superb collection of epicenters delineating tectonic plates is probably the single greatest accomplishment of such synoptic study. For an outsider, it is fascinating to see the outline of the rifts and joints. At last we understand something of the earth in the large. At the same time, so cavalier a dismissal of the entire history of a science is breathtaking.

The lesson is quite plain: nobody, not the most single-minded proponent of computer data processing, would say that it all began in 1961, even if our modern compatible data began then. The past was an indispensable prologue; it saw the formation of concepts, the development of techniques, the introduction of instruments, the idea of systematic recording, and so on. All this showed the way, without which I am sure the Coast and Geodetic Survey and its friends would not have been able to produce so beautiful a map.

Perhaps that is a story we are facing in all disciplines. It is quite possible that a similar scheme with its similar swing of a scythe may eliminate even human theorem secreters, will produce ten million machine-made mathematical theorems per year. But that should not mean that mathematicians are rendered void. We find in man's history previous episodes of the inanimate simulating the animate, from which man has emerged unscathed.

Life as Motion

"For ancient and medieval people there was not much difference between jugglers, alchemists, mechanicians, leeches, star clerks and all such dealers in magic and gramarye."—Joseph Needham.

We accept the idea of the juggler as half-magician. Yet all he does is exploit the fast reaction time of human beings, and the free-fall dynamics of small objects—plates or cones or bowls—in that striking way which so delights the eye, and has uninterruptedly done so for at least 3,000 years, by direct archaeological

The hidden mechanism of the Draftsman, created by Henry-Louis Jaquet-Droz and Jean-Frederic Leschot in 1774. An upper clockworks drives a shaft upon which are mounted a set of cams. The shaft rotates once, then releases a lower clockworks, which pushes the cams upward and then sets the upper clockworks in motion again. Thus the "instructions" encoded upon the cams in a system of polar coordinates can be transmitted in turn to the Draftsman's hand by means of a mechanism in the elbow, which also moves the eyes and head. During pauses in the execution of drawings while the set of cams is being incrementally moved, the Draftsman blows on his drawing to free it of dust.

Two of the Draftsman's repertoire of four drawings are shown on the next two pages—left, a portrait of Louis XV; and right, *Mon Toutou,* my "bow-wow."

The "*androides*" of Jaquet-Droz are in the Musee d'Art et d'Histoire in Neuchatel, Switzerland, where they are demonstrated on the first Sunday of each month. The illustrations of two Jaquet-Droz automata—the Draftsman and the Writer—that accompany this article are from the Musee d'Histoire and its *Conservateur,* Jean-Pierre Jelmini.

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This article is adapted from Professor Morrison's Closing Address at a conference on "The Computer and the Development of Science and Learning," held at the Institute for Advanced Study, Princeton, in June of 1972. A transcript of Professor Morrison's address will appear, with texts of other contributions to the conference, in an issue of *Daedalus* (7 Linden Street, Cambridge, Mass., 02138) to be published late in 1973.

evidence. "Alchemists," of course, are people who change matter from one form to another. "Leeches?" I leave the American Medical Association to deal with them. "Star clerks?" Plainly, dealing with the motions of the heavens was beyond the common work of man, beyond primary production, foreign to the social arrangements which make society. Outside us are the stars, with their extraordinary rhythmic motions; those few persons privy to those unique motions had a special role in society. But "mechanicians" hits hard in a mechanical age.

Is this not striking? In the commonplace, banal arguments of today, we contrast on the one hand the spiritual, the aesthetic, the insightful, and on the other hand the dully mechanical. The mechanician embodies the lowest form of intellectual expression!

Though Needham is a modern man, he is able to put himself into the framework of the mind of an older time. He can view mechanicians as being among those persons who deal with magical things. At a time when there was no mechanical prime mover, before even wind- and water-mills, all motion was animate in origin, save the ineffabilities of the waves, the waterfalls, the clouds. At that time—only 3,000 years ago—mechanical contrivances were not economic devices, common in everyday life; they were neither conveniences nor even time-keepers. They were magic.

It will turn out that as far back as we can go in the archaeological record, we will find mechanicians, *quasi*-magicians, seeking to simulate in their magical devices two great classes of natural motion: the motion of life and the motion of the cosmos.

The first class, the simulation of life of immediate importance to our topic, is the mechanism that could move by itself. Even today, the feeling of a child who is somehow kept away from a surfeit of machine contact (as was every person of 2,500 years ago) is that motion—on any scale save that of the great semi-cosmic motions of the winds and the waves, or of felled trees and the like—necessarily means life; motion means "animation"; the "quick" as opposed to the "dead." Animals move; birds, fish, insects move; but nothing else on our scale moves of itself. The first type of device, then, is the self-moving artifact, motion created by magicians as a philosophical simulacrum of life.

There is a long tradition of found artifacts which represent this. The oldest one I know of is a so-called "Jackal of Anubis" from early dynastic Egypt, a figure of a jackal with a jaw that can be moved from behind by strings. One imagines the image apostrophized in the right way in the temple. Its jaw moves while the priest speaks behind it, giving some special dramatic authenticity to its utterance.

Richard Gregory has made a strong case, based on archaeological evidence and plausibility (we are told that is the historian's method), that in the Egypt of the Middle Kingdom, the faces of some temple statues were made concave instead of convex. In consequence, as one walked by this image hollowed out like the inside of a mask, instead of protruding as does the outside of a mask, one's failure to immediately understand the perceptual data meant that parallactic shifts in viewpoint caused the features to appear to move. It is a striking phenomenon. A similar illusion is seen nowadays in looking at pictures of the moon, attempting to decide whether visual prominences are craters or

bumps. This illusion in the form of a statue perhaps makes the statue appear to possess a strange self-motion: it becomes animated, seemingly alive.

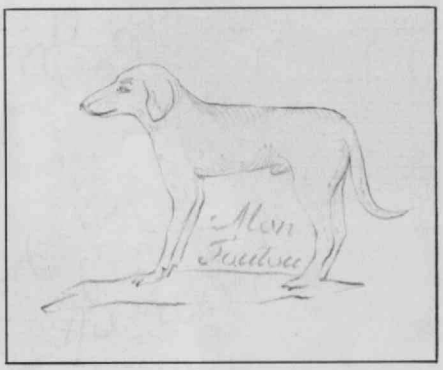
We have a very limited literary legacy of the Greek tradition of mechanism. Everyone knows the famous name of Heron (or Hero), writing near 100 A.D., and his teachers to whom he specifically refers and in whose tradition he was plainly working, who stretch back in time about to 250 B.C. One fragment of Hero is perhaps the best known; it is the only one with an English translation, though the *Automata* by Hero has a famous version in German and there are fine scholarly studies on all his existent works. Everyone has looked at this most famous figure from the work of Hero: the little steam proto-turbine, a little ball of copper with nozzles coming out, all mounted on an axis. Water inside is heated, and steam jets out so that it spins. What one realizes when one looks at the *Automata* is that the entire volume is a discussion of what can only be called mechanical magic: theatrical effects made by mechanical movement—statues that appear to drink, brass horses that drink even after their heads are cut off, much more.

It is dangerous to quickly dismiss this as merely an eccentric and bizarre foreign body lodged in Greek thought. Admittedly, it is not what we were brought up to believe. We believe in the purity of the Greek intellectual life, in its freedom from crude mechanism, its grave concern for the high issues of beauty and truth. But scholars have found mechanism even in Plato. In the cosmological section of the *Timaeus*, Plato describes a model in front of him, a real physical object—a kind of armillary sphere. I cannot say this is a majority view of scholars, but allowing for the extraordinary bias towards the written word which historians must necessarily hold (especially those who translate for us from the Greek), I find it an extremely likely theory. The whole story (in the *Republic*) of the shadows in the cave, one of the most famous images in all of Plato's arsenal of parables, can be very easily seen as a slightly displaced description of some actual puppet theater, or shadow theater, such as we find used in folk drama in many parts of the world to this day, not least in Greece.

Each of the only two or three of Hero's books that we have is a sharp account of a series of theatrical effects, including the mechanism—weight- or water-driven—by which they can be executed. The weights do not fall freely but against a cord which very slowly untwists, allowing a valuable change in tempo.

There is a play in five scenes for the automated theater which we know was performed automatically —that is to say, by automata—for over 400 years in Hellenistic times. The best drawing we have shows a theater of dollhouse size on a pedestal. We will rely here upon Richard Brumbaugh, and upon Hero's account of the plot.

The curtains open. There appear twelve figures, arranged in three rows: the Danaids, who are repairing a ship and moving it forward to be launched into the sea. These figures move busily: one is sawing, others are hammering, yet others work with large and small hole-boring tools. There is a great noise, as of the sound of actual working. After a predetermined time the curtains close; then, opening again, another



scene is revealed. One sees the ship of the Achaeans launched in the sea. After the curtains have closed and opened once more, there is only empty sky and painted sea in the background. After a short time, ships sail into view in a line. As one disappears, another enters; dolphins swim along with them, diving into the sea, then becoming visible, just as they really do. There are three dolphins attached to three arms, which pivot just below stage level, so that as a shaft turns, the dolphins leap out of the sea, and dive in again. A very nice effect! Shortly thereafter the sea becomes stormy and the ships run with sail close hauled. When the curtains have once more closed and opened, nothing of the ships can be seen, but there stands Nauplius the King with Athena, and fire burns above the stage. The scene again changes. The shipwreck of Ajax's boat appears, and Ajax swimming. A machine raises Athena out of view; thunder crashes and a bolt of lightning falls directly from above onto Ajax, who is made to disappear.

In falling, the lightning bolt twists up a cord, so that as soon as it is down the untwisting will bring it back up again sharply. So, zip, zip it goes, down and up again, and in

Though it is more complicated than the Draftsman, the Jaquet-Droz Writer was made two years earlier, in 1772. It contains three sets of 40 cams each, all mounted on the same shaft. A combination of pressures exerted by three cams—one from each of the sets—on three levers guides the Writer's hand in forming letters, and varies downward pressure sufficiently to create light and heavy strokes. A two-thirds revolution of the cams produces a letter, and the remaining third brings a stud of varying height into contact with a mechanism that spaces letters properly.

While this happens, a disc operated by a second clockworks is rotating. Around the periphery of this wheel are 40 wedges, each of which in turn comes into contact with the shaft, pushing it to a height required to bring the three cams required for a chosen letter into contact with the levers. By setting the heights of the 40 wedges, any text can be chosen.

Other mechanisms in the Writer end its operation after it punctuates its sentence with a period, and induce the arm to dip the pen into an inkwell and then shake the pen twice.

At right, the Writer's calligraphy.

that brief time the poor Ajax figure is pulled away. Thus does the clockwork story of the Gods' vengeance upon a murderer come to a conclusion, as stage doors close!

The play is presented not by theater people, not by artists, not by poets. It is a play presented by mechanical engineers. Surely it is the "simulation of life"; it cannot be doubted that this is an important strain in Greek thought, though it appears only in these few books.

Clockwork Life

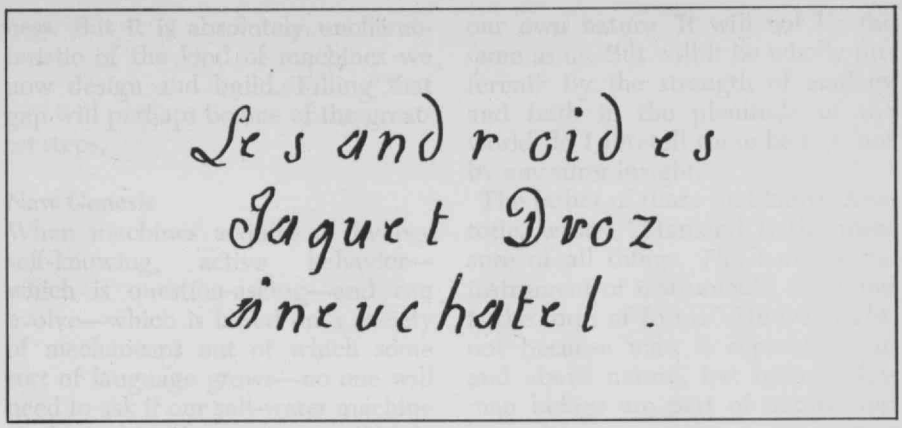
A simulation of animate life and a mirroring of cosmology were fused in the time of the Enlightenment, when clockwork, stimulated by the enormous development of precision craftsmanship and understanding in Europe, succeeded in producing for the first time mechanisms capable of fulfilling this program of the ancients in full. The near-absurd example is the cuckoo clock, but I hope that we will instead recall the wonderful cam-driven clockwork analog machines of the late eighteenth-century Swiss automaton makers whose expertise forms the ancestry of the watchmakers of today in Neuchatel, Switzerland. There, on the first Sunday of every month, a curator proudly displays the automata of Jaquet-Droz: figures, two-thirds life-size, beautifully dressed in the costumes of the time, driven by quite elaborate cam-work. One figure is capable of writing, in a fine, handsome, proper little French Alexandrine verse authored by Droz, evidently a talented fellow. Another figure, a young girl, plays on the harpsichord a little piece also composed on the side by Droz. A draftsman draws line figures of Cupids hauling chariots, profiles of Louis XV—four pictures in all.

These were the last of a tradition. Forty years before, de Vaucanson had made a real hit in the early Enlightenment courts, especially at the court of the Sun King himself, with a series of rather droll, not to say raffish, automata. The most famous of these was a duck which was presented to Louis and his courtiers. It quacked, flapped its wings, bent over, ate grain, and then excreted, all there on the table. Let the biochemists laugh a little bit; on a gross level, life was simulated.

As recently as the nineteenth century and in the relatively mundane technology of mechanisms devised

not as wonders but as satisfactions of practical needs, we yet find the fascination with motion of the inanimate. In the nineteenth century, the quality of the new non-wind-propelled, non-horse-drawn, inanimate vehicles was something that still appealed to the popular imagination. I have read that even in the early twentieth century on the plains of Russia and Poland, as you drove by in the very rare automobile, the peasantry might come to demand to look under the hood for the treadmill-pacing animal that they fully expected to find inside.

But for us the magic has gone from clockwork. It is now only some kind of humdrum putting together of gears. It has in principle all been solved, and that's it. So the fashions go with the centuries. But there was once a time when gear trains seemed a magical simulation of life—just as the phenomena might be that we anticipate or fear coming out of the powerful digital computer of the future.



The Simulation of Intelligence

So far, prolog. Now, the current issue:

Mankind once distinguished life from non-life by purposeful motion, until seemingly magical machine simulations voided that criterion. Here and now, in an age of computers, how shall we understand the uniqueness of life? And what will we have to say of our own minds if machines come to think?

The eighteenth-century simulacra of life established once and for all that it is not by intricate, purposeful motion that living matter is unique. We see now that nor is life unique in having many internal states, for our electronic machines have that. The uniqueness of life is not in the irreversible separation of parts of the organism either, though 40 years ago, this was a life/non-life distinction: in any machine take a part out, and put it back again, and the machine works. Take a part out of a man, and put it back in again; he does not work. By now this seems a very naive criterion, wrong on both sides, but 40 years ago it was a true distinction.

Introspective self-examination? We do not have much of that in our machines. We do not now have machines that reflect even in a small way upon their inner states. They ought to, and certainly if machine design is done in a philosophical spirit, that is the one property that ought not to be left out. Even now, the mere existence of memory-rich machines makes it extremely hard in reality to ignore inner states and accept any stimulus-response theory, any input-output view in which the processing takes place in a "black box" about which nothing need be known. This is not likely to be adequate to represent a machine, a mammal, or a human mind. So much depends on the memories on a computer's discs that the black-box approach of the behaviorist never occurs to a machine repairman. The machine is a functional of its history. The repairman would be quite lost even in the presence of a simple machine without some sense of what I would like to call the introspective concerns of that machine—

No, that is not quite true yet; I have jumped the metaphor one level more than I am entitled to for the present. But the gap seems only an economic one. In the efforts ahead in artificial intelligence, I would demand, as would an old psychology test, that some trace of self-examination be provided. A machine lacking that goes far toward overlooking the principal philosophical differences between behavior, and behavior with conciousness.

Machines and Mind

We must now ask the question: "Can a machine be comparable to the human mind?" That is what I have surely been preparing to consider. I think I have given enough background to prove this is a legitimate philosophical question, an important one, moreover one we have already met for five thousand years, on one or another level.

I fully believe that we will find no barrier to success in any aspect of machine simulation, in any feature of full machine reproduction of any canon whatever of human mental states. I think that what looks to be true will probably turn out to be true; namely, that the human mind can be described as a slow-clockrate modified-digital machine, with multiple distinguishable parallel processing, all working in salt water. Yet I will say that all those subtleties philosophers and artists talk about, that make life unique and distinguish it from non-life, are true after all, foolish as they may sound when you are young and enthusiastic, and have a naively positive view of science. I offer a position of tension, a determined yes, machines will simulate life, but. . .

Mind as Questioner

We begin with a statement from a considerable scientist of our own generation, Sir Fred Hoyle, who very stoutly said to me once that the only important thing in science is to ask a good question. An answer will appear; it is eternally implicit in the process. The person who asks the right question is the truly great scientist. That is exactly what is written on Cantor's gravestone in Latin, so I can cite even a better authority than Hoyle, namely Cantor himself: the question is the essence of science.

Then the notion that thought can be judged by the answers to an interrogation process is much too low a level of test for respectable mental behavior. I will not be satisfied with the machine that claims to simulate human mental life until it asks important questions, raises new problems. That is what I regard as fully human behavior (or at least part of it): not merely answering, however cleverly, however subtly, however neatly picking up literary allusions to Shakespearean sonnets. Merely

answering questions is not going to do the job. I can almost conceive of a question-answering machine, but a question-asking machine? That is more of a challenge. On the other hand, such a machine, because of imperfections, because art is long and life is short, will lack some of those complex essential features which together made a whole enduring social being out of ourselves after five billion years of earth's history.

But wait: there are strongly limiting constraints on this oracular delivery!

First, a machine simulating the human mind can have no simple optimization game it wants to play, no single function to maximize in its decision making, because one urge to optimize counts for little until it is surrounded by many conditions. A whole set of vectors must be optimized at once. And under some circumstances, they will conflict, and the machine that simulates life will have the whole problem of the conflicting motive, which we know well in ourselves and in all our literature.

Second, probably less essential, the machine will likely require a multisensory kind of input and output in dealing with the world. It is not utterly essential, because we know a few heroic people—say, Helen Keller—who managed with a very modest cross-sensory connection to nevertheless depict the world in some fashion. It was very difficult, for it is the cross-linking of different senses which counts. Even in astronomy, if something is "seen" by radio and by optics, one begins to know what it is. If you do not "see" it in more than one way, you are not very clear what it in fact is.

Third, people have to be active. I do not think a merely passive machine, which simply reads the program it is given, or hears the input, or receives a memory file, can possibly be enough to simulate the human mind. It must try experiments like those we constantly try in childhood—unthinkingly, but instructed by built-in mechanisms. It must try to arrange the world in different fashions.

Fourth, I do not think it can be individual. It must be social in nature. It must accumulate the work—the languages, if you will—of other machines with wide experience. While human beings might be regarded collectively as general-purpose devices, individually they do not impress me much that way at all. Every day I meet people who know things I could not possibly know and can do things I could not possibly do, not because we are from differing species, not because we have different machine natures, but because we have been programmed differently by a variety of experiences as well as by individual genetic legacies. I strongly suspect that this phenomenon will reappear in machines that specialize, and then share experiences with one another. A mathematical theorem of Turing tells us that there is an equivalence in that one machine's talents can be transformed mathematically to another's. This gives us a kind of guarantee of unity in the world, but there is a wide difference between that unity, and a choice among possible domains of activity. I suspect that machines will have that choice, too. The absence of a general-purpose mind in humans reflects the importance of history and of development. Machines, if they are to simulate this behavior—or as I prefer to say, share it—must grow inwardly diversified, and outwardly sociable.

Fifth, it must have a history as a species, an evolution. It cannot be born like Athena, from the head full-blown. It will have an archaeological and probably a sequential development from its ancestors. This appears possible. Here is one of computer science's slogans, influenced by the early rise of molecular microbiology: A tape, a machine whose instructions are encoded on the tape, and a copying machine. The three describe together a self-reproducing structure. This is a liberating slogan; it was meant to solve a problem in logic, and I think it did, for all but the professional logicians. The problem is one of the infinite regress which looms when a machine becomes competent enough to reproduce itself. Must it then be more complicated than itself? Nonsense soon follows. A very long instruction tape and a complex but finite machine that works on those instructions is the solution to the logical problem.

One cannot say that the slogan does justice to the extraordinarily complex structure of the "D.N.A. dogma," in which we have the D.N.A. "tape" and the mechanisms whose instructions are encoded upon the D.N.A. That microbiology is positive science. The rest is slogans, but the slogans are powerful ones. They establish in the language of computer science at least the logical possibility we see realized in life: the self-reproducing system. And they do so by a means that makes evolution possible.

By the time I have described all these attributes of a machine to simulate life, I suggest that I have described something which is more like the human mind than it is like our image of the machine. Yet life is not mocked. Mechanical this simula-

tion of life will nevertheless be—as clockwork motions are mechanical.

Nobody believes today that the slightest insight is offered into the nature of organic life by the fact that a clockwork mouse can run across the floor. But there was a time when the wisest people thought that the existence of a simulation of purposeful motion had to be demonstrated. Now it is only a proposition in the transfer of energy and forces on the floor, and we know too much to accept that as a special property of life.

In the same way, I think, we will see man creating a simulation of other aspects of life, yet without creating a *doppelgänger* of the human mind.

Aspects of the Simulation

In one respect, the human mind works in a way that hints at the methods of a computer. Abstraction of perceptual information comes very early in the human mind's processing of sensory data; it begins at the level of the peripheral organs. Images are not transmitted from the eyes to form a picture in the brain so that an homunculus in the cortex can look at the picture to decide what it is. Descartes in his day found that idea problematic. Since Hubel and others, we know that aspects of the image are coded right away—abstract items like diagonal lines. An object running out of the field of view might induce a signal that appears at some point—I don't know where—in some junction box behind the lateral geniculate, or some other complicated anatomical region. But quite early the inputs are transformed, not into point-for-point spatiotemporal representations, but into a more abstract language, one suitable to the machine.

There are, though, chasms between computer design at present and the apparent workings of the mind. Contextual information concerning the meaning of symbols seems indispensable for any economical machine program that has a chance of being "intelligent." The notion that it can all be done by logical manipulations of these symbols, without any reference to their contexts, is inadequate, for the presentation of many distinct contexts to the central processing device is characteristic of all living beings, characteristic especially of human beings in a social environment of extraordinary richness. But it is absolutely uncharacteristic of the kind of machines we now design and build. Filling that gap will perhaps be one of the greatest steps.

New Genesis

When machines acquire a diverse, self-knowing, active behavior—which is question-asking—and can evolve—which is based on a society of mechanisms out of which some sort of language grows—no one will need to ask if our salt-water machine works in just the same way. We do not argue about the fact that a little mechanical mouse runs along the floor more easily on wheels, not on legs. It is locomotion, all right, differently realized.

We can have creative and personal machines, structures which will act and reflect, and they will share to a degree the attributes of the kind of persons we ourselves are—attributes which we gained by evolution. If the machine does not share those properties, it probably will fail to attain the special high functions of the mind which I have described. My argument arises only out of a sense of the deep unity of the world, a unity which does not demand similar structure for similar functions, but does demand the kind of coherence to which I offer homage.

I do not myself expect to see, but the world may well witness, four kinds of "life." First, there is our own kind, life continuous by descent over some four billion years, with a heritage of certain antique biochemical ferments. There will be a second kind, born in a glass test-tube. It will have a new and discontinuous genesis, on quite a different path of information transfer. Perhaps the amino acids will be the mirror images of our own! There will be life of still another sort on another planet. This may be only the Martian fossil plants of the cold pole, or it might even be a fully-conscious life evolved around another star than ours, made known to us by a marvelous microwave link. Finally, there will be a synthetic device, far from biochemistry. It will not have been designed from the beginning by some human programmer, but begun at a higher logical level by humans, to evolve its subsequent internal hierarchies out of its own structure and experience. Once complete, it will behave in the ways I have outlined, in a manner akin to our own nature. It will not be the same as us. But will it be wholly different? By the strength of analogy and faith in the plenitude of the world do I foretell these beings; not by any surer insight.

The father of those that know, Aristotle, wrote: "Mankind is the measure of all things. The hand is the instrument of instruments, the mind is the form of forms." He was right, not because man is separate from and above nature, but because human beings are part of nature and have been engendered by nature over several billion years. We can expect then to take from our own behavior lessons which may one day lead us to the synthesis, the wondering synthesis, of machine beings, somehow alike and yet very different from that consequence of a cunning, age-old, half-unerring, yet half-random, chain of evolution.

Suggested Readings

Joseph Needham wrote the quoted remark about the magicians of mechanism in his great *Science and Civilization in China* (Cambridge University Press, 1954), volume 1, page 197. For the illusory sculpture of the Egyptians' gods, see Richard Gregory's *The Intelligent Eye* (McGraw Hill, 1970). Greek work and thought in the simulation of life, including the play for the clockwork theatre, is discussed in a little popular book whose lightheartedness and freedom from pretension should not be allowed to conceal its originality and depth: Robert Brumbaugh's *Ancient Greek Gadgets and Machines* (Crowell, 1966). The history of automata is contained in the richly figured monograph by Alfred Chapuis and Edmond Droz, *Automata* (Neuchatel, 1958. Though this English edition is exhausted, a French edition, *Les Automates,* is available from the publisher, Editions du Griffon, in Neuchatel). Derek Price first put thoughts like those in this article in a paper in *Technology and Culture,* Vol. 5, No. 9 (1964). He has alluded to these matters in nearly all his works since then.

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Engineering and Societal "Software"—a New Imperative

When the U.S. was mostly virgin territory, engineers were mainly concerned with building machines and structures, and systems of machines and structures. Civil engineers—who were among the earliest—built roads and bridges and opened up the country to mining engineers, who extracted materials. Metallurgists and mechanical engineers processed and fabricated these materials into useful configurations and devices. Agricultural engineers mechanized farming and greatly increased food production.

Indeed, until about 40 years ago we can say that engineers were expected to direct their efforts mainly towards improving man's *physical* well-being and this they did. They provided roads and transportation systems, utility systems (power, communications, water), manufacturing establishments, housing and offices, durable goods, and consumer goods—more things for more people, through technology. Engineering success was measured in terms of industrial growth, productivity, and marketability; the engineers' typical guiding concepts were feasibility, reliability, life expectancy, safety, efficiency, and mass production—all of them being heavily influenced by the demands of the marketplace, and all related to the satisfaction of material needs at the lowest economic costs.

More recently, and very much as a result of the application of discoveries in modern science and in electronics and aeronautics, the nature of the impact of engineering has changed. Consider, for example, the effects of worldwide communications, the transistor radio, television, computers and scientific instrumentation, jet aircraft, rapid reproduction of documents, sophisticated drugs, and the widespread use of machinery to substitute for men in doing monotonous mental and physical work. Through such developments, the work of engineers now greatly affects our emotional and intellectual life, not just our material condition.

Our way of life is being changed in what I define as a "quality" sense—not simply in a physical sense. It is no longer simply that many live a more comfortable life, with more conveniences, than our forebears. We live in a different world. The gasoline engine has, in the last half century, altered the family by enabling each member to remove him or herself to a great distance at the merest whim. The television set is used in many ways, including the way upper class families once used a resident nurse—to dispose of the children; but its properties are not those of a nurse. From its advertisements, for example, the children quickly learn not to believe what they are told. They also develop expectations for things and activities that frequently stress their parents' budgets and bring about a new order of family life.

While national governments continue to dicker for dominance and to expect the single-minded allegiance of their citizens in whatever alliances they sign, the jet engine makes it very easy for those citizens to mingle, study each other's ways of life, and draw their own conclusions. Once, only the elite travelled in that way.

In other words, to inject technology into our society has anthropological connotations which, depending on how we plan and what we do, can be either subversive or benign.

Because of all this, I contend that engineers are revolutionists: they bring great change not only to their own profession, but also—and more than any other profession—they are the primary instigators of social, economic, and political change in the society in which they live.

We all know many people, both young and old, who have an uneasy feeling that all is not well. In the midst of affluence there is widespread poverty and an increasing gap between the "haves" and the "have-nots." The tempo of life has quickened so much that both "haves" and "have-nots" find themselves running more and more, merely to keep up. There is increasing crime, widespread increase in tension, economic inflation, degradation of the cities, excessive pollution, gadgets all around us that seem to be always breaking down, and a proliferation of undeclared wars.

More and more people ask, "Is a high standard of living synonymous with a high quality of life? Has it given us a satisfactory living environment?" Many of us answer, "No!" We have worked hard and produced affluence, but more and more we ask, "How is it that we can have so much—compared with any society, past or present—and yet not have what we want? What is the cause of all this concern in an envi-

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Gordon S. Brown came from Australia to study electrical engineering at M.I.T. in 1929; his doctoral thesis (1938) led him into pioneering research on feedback control systems—and this article makes obvious his continuing interests in these concepts. Since 1931, when he first joined the M.I.T. faculty, Dr. Brown has been successively Director of the Servomechanisms Laboratory, Head of the Department of Electrical Engineering, Dean of the School of Engineering (1959-1968), and Jackson Professor in the Department of Electrical Engineering.

Engineers' responsibilities do not end with engineering. They now must use their uniquely powerful tools to show how the structure of their society and its "software" must accommodate to the anthropological changes which their technology may bring about.

ronment of plenty? Is the stability of society decreasing?"

Some people, aware of the ever-growing impact of engineering in their lives, go so far as to say that technology is inherently subversive, and inevitably breaks down society. Others continue to believe that technology is "neutral"; if any product of technology has anti-social effects, it must be because its design and use have been guided (consciously or unconsciously) by anti-social impulses. In this view, what we see in this troubled world is simply the workings of man's usual imperfect will, with the imperfections technologically amplified.

Either way, it remains true that today's technology has qualitative consequences for human society.

The Bounds of the Material

Of equal concern are the quantitative consequences. Here the essence of the matter is much simpler and easier to grasp (although the details are complex and incompletely known as yet). It resides in two natural phenomena which, as embodied in our culture, are now becoming of vital importance to our future. One is exponential material growth, and the other—in fundamental conflict—is the fact that growth in any material dimension always, one way or another, encounters limits.

Many of society's processes grow upon themselves. For example, births in any interval of time are proportional to the population of childbearing age. Because the reproduction cycle is brief compared to the span of life, a male and female can reproduce themselves several times during a lifetime. The process can be expressed mathematically as exponential change, and when births exceed deaths there is exponential growth. With an annual growth rate of 25 per 1,000, the population doubles about every 30 years.

World population was less than 2 billion when I graduated from college; it is over 3.5 billion today and appears certain to be at least 5 billion at the turn of the century. If rates do not change, there will be about 10 billion people by the year 2030. Many of today's teenagers will live to see that time.

The physical consequences of the exponential growth in population are compounded by the expanding expectations of people everywhere for more affluence and for better living. So there is doubly rapid growth in industrialization, in the consumption of raw materials, in pollution.

It is obvious to anyone who does the arithmetic and reads the signs that there are limits to the world's physical resources and that we are coming within reach of some of these. Already, the United States has outgrown many of the resources of its own territory. The Office of Emergency Preparedness reports that the U.S. is now entirely dependent on foreign sources for chromite, columbium, mica, rutile, and tin—all strategic materials. Such materials as antimony, asbestos, manganese, platinum, cobalt, bauxite, nickel—to name only a few—are not produced in the U.S. in sufficient quantities to serve as an adequate base for our automobile, aircraft, and defense industries.

In the span of a few decades, the U.S. has moved from being natural-resource rich to natural-resource poor. And U.S. demands for most natural resources are within an order of magnitude of the total demands of mankind—in many cases, within a factor of four.

Within the past year or two we have heard a lot about the energy crisis. With a continuing 8 per cent annual growth in electric energy consumption, the doubling time is about nine years, which means that during a decade we will build more than as many additional energy-consuming systems—computers, air conditioners, washing machines, machine tools, electric railroads, etc.—as we now have. To power them, we will have to build as many new generating plants—boilers, turbines, generators, fuel supplies, transmission lines, etc.—as we now use: a system that has taken 100 or more years to build must be reproduced in ten.

Furthermore, our technology is ever more complex and our efforts to control it ever more demanding; the time elapsed between the start of planning for a new large generator and its coming on line has now grown to between seven and nine years. From this it follows that to sustain current growth rates we must at any given time have about as much electrical capacity in the stages of planning, design, and construction as we then have in use. Consider what this would mean during the second decade from now: by 1990 we would be trying to achieve four times what we now have.

As recently as one or two doubling times back, the spectre of this sort of limit was out of sight and out of mind. Now we know the folly of that view. It matters little whether our data on growth are precisely correct; at a growth rate of only two per cent, for example (which in a demand context is perceived as virtual stagnancy), the doubling time is 35 years—half a human lifetime. If a crisis does not come during the

lifetime of our grandchildren, we can safely say it will come during the lifetime of our great-grandchildren.

I am convinced that the dimensions of our problem will inevitably become clear within the next ten to 30 years, for modern man has built into his societal system a doctrine of exponential growth that is not sustainable indefinitely in a finite world.

The previously mentioned qualitative effects of new technology upon the way we live are different in kind and in origin from this quantitative *impasse* for which we seem to be heading. Either is conceivable without the other.

But they interact in our lives, exacerbating one another. In the view of many, for example, overcrowding contributes to increased stress, crime and mental illness. Certainly, living and working among the machinery of a modern city, we commonly feel justified in wanting to "get away from it all," and we have transportation for the purpose. But suitable places to escape to are becoming limited in relation to the number of people who feel the need to use them. The conflicts increase between "recreational" and industrial land use, as do the conflicts between kinds of recreation (snowmobiles and transistors versus peace and quiet, for instance). This interaction gives the growth-versus-limits problem dimensions beyond mere quantity.

I do not wish to sound like a prophet of doom, because actually I am optimistic. I know there will be new discoveries and new technologies; in fact, they are essential if we are to do anything at all successful within the new boundary conditions.

But they will not be enough, and they will not happen automatically. The challenges faced by mankind and the pressures from within make it necessary that we exert a new level of self-discipline—that we begin to be selective in the technologies we choose to foster and the kinds of growth we demand, so as to move toward a life not merely of greater abundance but of mutual tolerability between man and the rest of nature, between man and man within nature's constraints, and between man's works and his own nature. We can say with certainty that at some time in the near future man must accept the inevitability of limits to growth in his numbers, in his consumption of material resources and energy, in his output of wastes (because there are limits to the capacity of natural systems to absorb them), and in each of his uses of land area.

The issue is not merely how long a resource will last. Modern man must ask himself whether he is entitled to consume or destroy entirely an irreplaceable resource for his purposes alone, to use it with gross inefficiency and largely for purposes which may be nonessential if not indeed frivolous. What are the rights of future generations? Associated with the assessment of these issues will be decisions involving not only measurables such as resources, pollutants and their physiological effects, but the whole range of human purposes.

Hardware and "Software"

This is the world in which engineers must work in the future—and for which engineering schools must prepare them now. Until the recent past, engineers' attention has been focused mainly on hardware. But too few engineers realize that their achievements in hardware have depended on a great deal more than science and technology.

Their past achievements have *been made possible by,* and have also *been moderated by,* developments within the total society that I will call "software." By the term "software" I mean the doctrines, the codes, the procedures, the rules, and in general the culture of society. One reason why it is easier to visit the moon than to repair our cities is that in the former case, the central "software" is trivial, while in the latter—concerning a place of human habitation—it is necessarily vastly complex, and very hard to modify. But these laws and customs are all man-made; and it is this "software" which must and will be changed as we come to recognize ever more clearly the limits of our traditional measures of value and power. For the continued success of engineering, at least some portion of the engineering profession must take part in remaking the "software" by which future society will be guided.

Though these leaders will be a new breed of engineers, this will not be the first time that engineers have faced the need to accept a major role in "software" development. There is a lesson in the experience of those who provided us with our digital computer systems. For just as the rules of the game in digital information processing are embedded in the software, so are the rules of the game in bringing technology from concept to the service to society imbedded in the "software" of the corporation, the banking system, the government, the trade union—even the church.

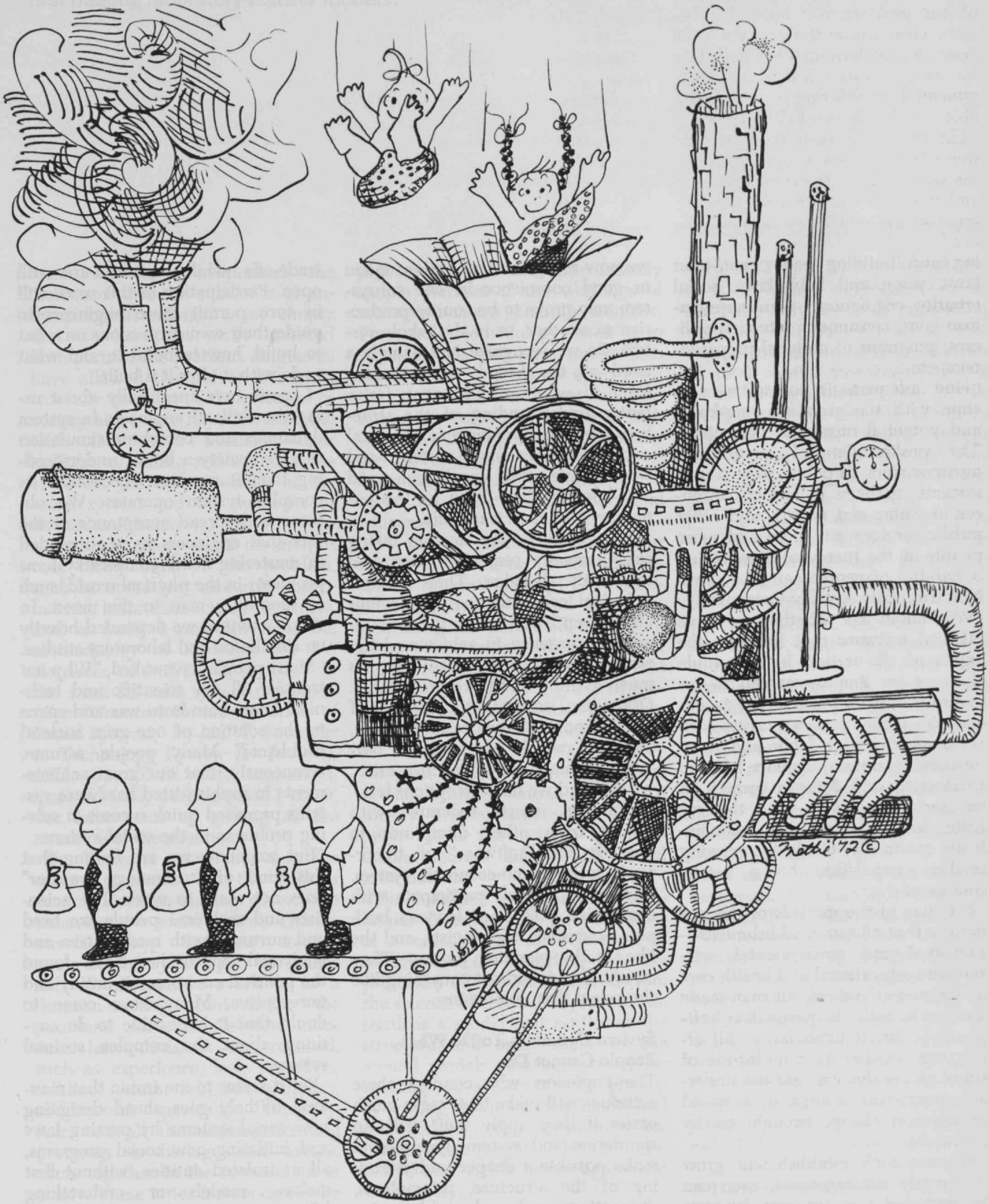
Beginning about 25 years ago, computer hardware engineers found that they could progress only by collaborating with people from other disciplines, such as mathematics, to develop routines for structuring the interactions between memory, processor, control, and peripheral equipment. To accomplish the information-processing objective, it was essential that the hardware and the software be compatible.

Now we have the same sort of problem on a society-wide basis.

As an example, consider the business corporation. It exists as hardware in its buildings, its plants, its production lines, and its products. But it is also people, and its style, its form of management and control, the way it relates to government and its markets, the systems whereby it and its people operate to fulfill its function—its "culture" if you will—are imbedded in what I call software.

On a larger scale are the software systems of international, federal, state, and city governments. Their software—extremely complex—pertains on the international level to tariffs, subsidies, raw materials policies (petroleum, minerals, and their effect on balance of payments), foreign markets, the aid given developing nations by the developed nations. On national and local levels, software embodies tax policies, environment protection policies, zon-

Science and engineering may in the past have been all that scientists and engineers needed to know. But no longer can engineers rely on a curriculum that embraces only mathematics, mechanics, thermodynamics, and a host of other disciplinary studies. The author's thesis is that engineers must now be so widely understanding of societal systems that they can join in remaking the "software" by which future society will use the products of technology. (Drawing by Mettie Whipple for *Science for the People*; reproduced by permission)



ing and building codes, anti-trust laws, wage and hour laws, social security regulations, nondiscrimination laws, consumer protection policies, programs of national preparedness, etc.

How adequate is our software to cope with the growing complexity and potential instability of society? The proliferation of government agencies, such as police, mass transit systems, garbage collectors, suppliers of water and energy, and other public services put more and more people at the mercy of monopolies. A handful of people can shut down New York City any day they wish.

We should ask whether we have evolved software that balances the rights of all parties. Is it possible that, as we employ capital to increase industrial productivity to offset high labor costs, we create software under which labor and management operate to displace labor in production and force a growth in the service sector in ways that we little understand—either economically or socially? Could the growing welfare population be a consequence of this?

It is one of the marvels of modern society that all our establishments—industrial and governmental, welfare and educational and health care and scores of others, all man-made and each with its particular "software"—exist simultaneously. All affect one another in a multitude of ways, all are dynamic entities undergoing constant change in a world of physical change brought on by engineers.

Because each establishment grew up largely autonomously, each can be regarded as a separate dynamic entity; and the people within it have this perspective as they establish their policies and procedures. But we now recognize that actions taken in good conscience in one subsystem may prove to be counterproductive in another, or in the whole system. So we recognize increasingly a need at the broad policy-making level in each establishment for a better understanding of the structure and the dynamics of the total socio-techno-economic system; and we recognize that, on all scales and at all levels, there must be less autonomy and more trade-offs.

Policy changes are slow in taking effect, usually requiring years and frequently decades. Their anthropological consequences are devious and deceptive. Hence, there is increasing urgency in achieving long-range planning—in predicting as much as is by its nature predictable. Otherwise, society will find itself always moving from crisis to crisis, many of which we generate ourselves. Whenever we are in a crisis, we will find we have no options left.

Engineers must federate with people from other disciplines to upgrade the "software" of tomorrow's socio-techno-economic system. They must actively participate with economists, politicians, lawyers, business executives, sociologists, and the like, in the planning process. They do not do this today to anything like the extent that is necessary.

System Dynamics To Do What People Cannot Do

The engineers who conduct these activities will make their tasks much easier if they apply their skills in simulation and system dynamics to make possible a deeper understanding of the structure, interactions, dislocations, and modes of behavior of the social system. They will thus provide a framework wherein society can test hypotheses and select trade-offs while options are still open. Participation in this work will in turn permit these engineers to guide their own professions on what to build, how to build it, and what to do with it after it is built.

I speak here specifically about using the skills of engineers in system dynamics and computer simulation to give society a better understanding than it now has about how its complex system operates. We observe widespread acceptance of the fact that engineers have succeeded in mastering many complex systems problems in the physical world, such as sending a man to the moon. In these activities we depended heavily on simulation and laboratory studies.

Many people have asked, "Why not transfer all our scientific and technical know-how from war and space to the solution of our grim societal problems?" Many people assume, erroneously, that our great achievements in sophisticated hardware systems promised quick success in solving problems in the social system.

But somehow we are finding that this kind of "technology transfer" does not seem to work. The scientists and technical people we bred and nurtured with quantitative and analytical approaches have found the political environment untidy and unreceptive. Many have come to doubt that it is possible to do anything about the complex societal system.

Yet it seems to me ironic that mankind blithely goes ahead designing new social systems by passing laws and initiating new social programs, all as isolated entities, without first making models or undertaking laboratory tests, when we all agree that social systems are more complex than physical systems. I say that in our obsession with hard-

If social systems are more complex than physical systems, is it not ironic that we persist in designing new social systems by passing laws and initiating programs without first making laboratory tests or models?

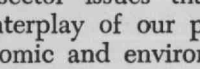
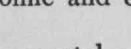
ware we have overlooked the "software" and the subtleties of anthropological change. I say simply that we have not really attacked both parts of the problem. Engineers have allowed themselves to remain woefully ignorant of the software of society and hence have not used the tools they have available—their skills at modelling and simulation—to reveal the true structure of the social system and the dynamics of its modes of behavior.

There are many fields of analysis that throw light on the problem, such as operations research, econometrics, behavioral science, statistics, and so forth. I especially like the methodology of Professor Jay W. Forrester of M.I.T., as revealed in the work he calls system dynamics. (*See "Counterintuitive Behavior of Social Systems," by Jay W. Forrester in* Technology Review *for January, 1971, pp. 52-58.*) It emphasizes, more than any other method I know, the importance of getting at the structure of the situation.

Dr. Forrester points out that the system structure and the policies used in decision-making govern the behavior of a social system. The interrelationships between components of the system and the channels of information available at a decision-making point define the structure. All rationale that influence how decisions are reached, such as experience, law, prejudice, folklore, ethics, religious attitudes, self-interest, generosity, integrity, fear, and all the action-generating processes in biology and nature, come together in the formulation of policy. These latter factors cannot be expressed in simultaneous equations, of course. But the structure of the system upon which policy acts can be expressed, and to do so is an improvement upon the unrealistically simple pictures of the workings of society which are generally used. Dr. Forrester's methodology leads us to ask questions that have rarely been asked before and stands apart from the traditional mathematical substance of economic science, which is not well adapted to embracing the public-sector issues that arise from the interplay of our political, social, economic and environmental concerns.

We all use mental models in our day-by-day behavior. In the application of his methodology, Dr. Forrester starts by listing and then diagramming the perceived cause-and-effect relationships taken from our mental models. He rightly states that such models held by a group of perceptive individuals contain far richer detail than has ever been reduced to writing, and they are usually complete, diverse, and sensitive to the localized causal forces in a society. The construction of a computer model draws upon all information sources that furnish useful information.

The localized cause-and-effect relations describing the separate parts of a social system are selected and interconnected according to the principles of structure derived from the science of feedback systems. The result is a model that replicates the structure and assumptions of the mental models now being used for running our society. In the process of writing down the statements and relationships, each assumption becomes more explicit, better organized, and yields wider agreement with reality.

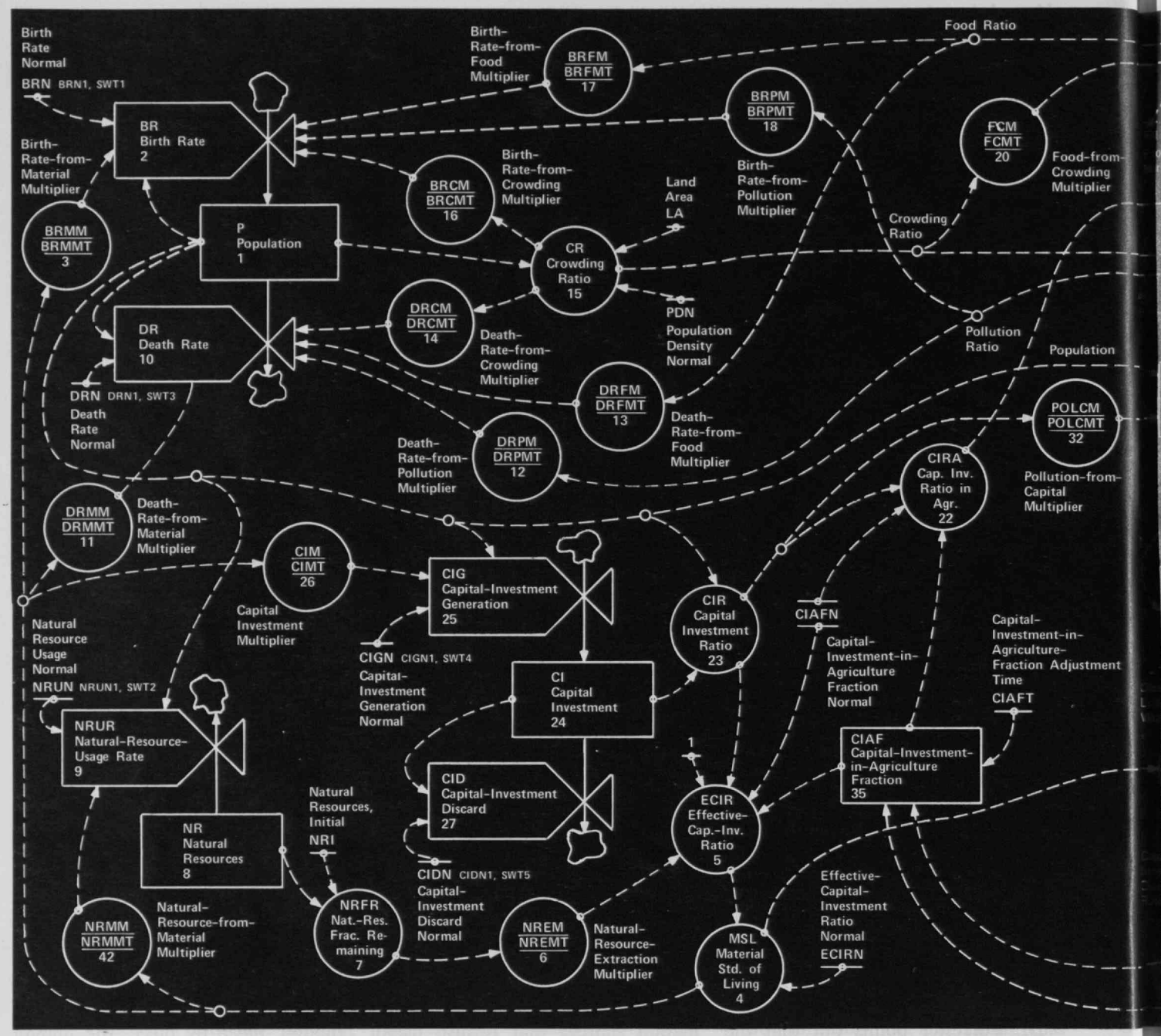
The diagram on pages 26-27 reproduces, as an example, Dr. Forrester's world model as first published in *Technology Review* in January, 1971 (*pp. 56-57*). Admittedly, it is a highly aggregated model involving only levels of population, pollution, natural resources, total capital investment, and the fraction of total capital investment that is made in agriculture, but it has yielded valuable insights about the behavior of the world system. The diagram shows the levels as rectangles  and the factors that change the levels as valves  . The difficult part of the work is to think through the factors and phenomena that operate to cause changes, and to interconnect them in a manner dictated by the system structure. The task of describing in simple statements that can be fed into a computer what goes in the circles ○ , and the relationships defined by the dotted lines, taxes the ability of people who undertake to work on these problems.

It is clear as one looks at such a model why the human mind has difficulty solving completely the dynamics of the whole situation—even though, piece by piece, the human mind may understand the situation very well. The computer is used to do what the human mind cannot do.

The computer solutions show the dynamic consequences through time of the assumptions stated in the model. As Professor Forrester has pointed out, the consequences are often unexpected, as model and computer solution together reveal the inconsistencies and contradictions that exist within the judgments which men reach on the basis of only their mental models.

A Hierarchy of Models

I do not propose that the goal of a simulation study lies most directly in "predicting the future." Its purpose rather is to give understanding of

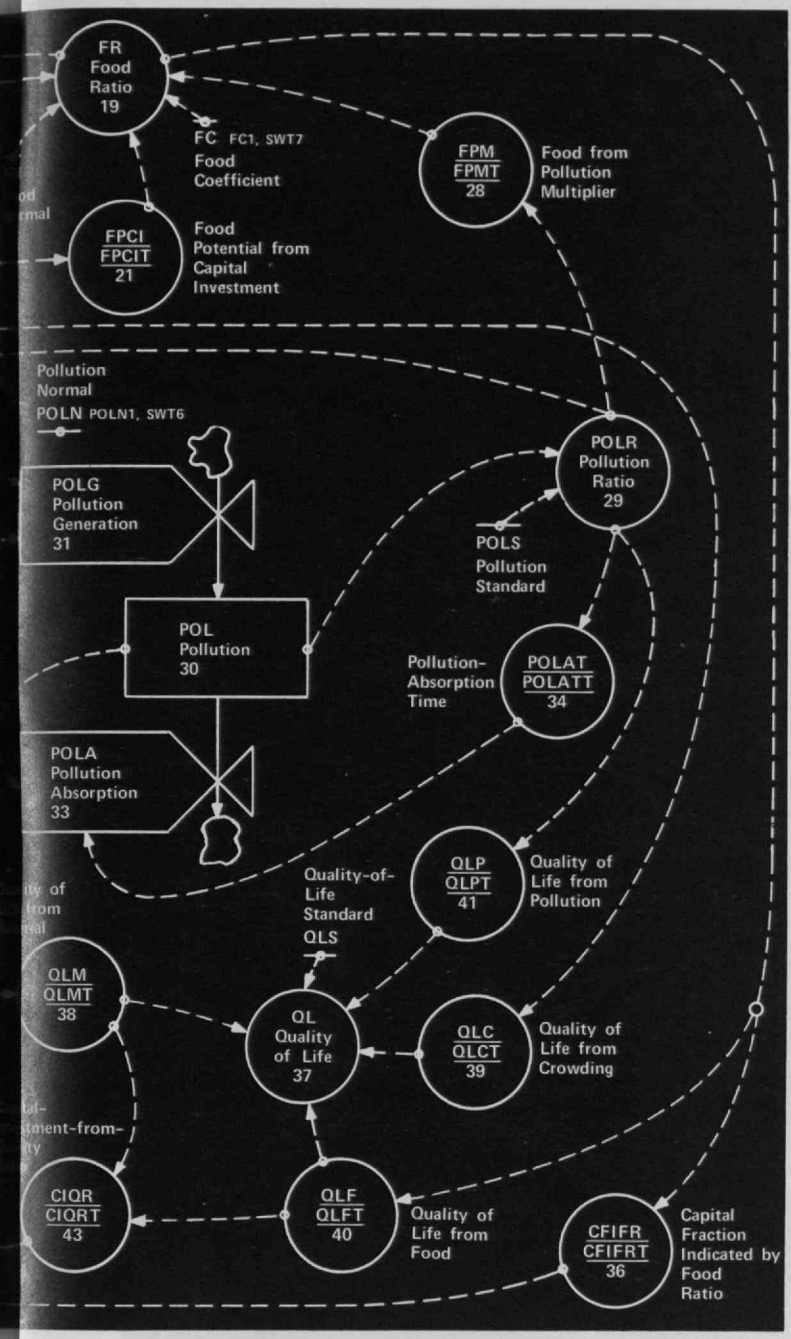


The work of Jay W. Forrester, Professor of Management at M.I.T., shows that engineering methods can help us understand how "software" and "hardware" interact. This is Professor Forrester's computer-based model for the intricate "software" system which links population, pollution, natural resources, and capital investment into world development. Most of us have mental models by which we attempt to visualize the interrelationships in such an intricate system, but Professor Forrester's work shows that many intuitive conclusions we draw from our mental models encompass inconsistencies and contradictions.

how alternative changes in a system associate with modes of behavior over time. For example, many conditions can be visualized as characterizing the world several decades from now. Three that come to mind are international military conflict, widespread epidemics, or prosperous equilibrium. The chart on page 28, from *World Dynamics*, illustrates one set of conditions that could establish a world equilibrium. It was achieved by assuming that in 1970 the world's capital investment rate is reduced 40 per cent, birth rate is reduced 50 per cent, pollution generation is reduced 50 per cent, the rate of natural resource usage is reduced 75 per cent, and food production is reduced 20 per cent.

The issue at the moment is not whether these assumptions are correct or achievable; indeed, one may reasonably argue that a system dynamics model is, as of now, of limited value in predicting exactly which one of a selected set of these conditions will come about. But I believe there is no doubt about the usefulness of a dynamic model in indicating how alternative decisions alter the tendency of the system to move toward any one future or another.

In the dashed lines of the world model (*above*) are embedded the rules and policies—the "software"—by which society is operating. Elements of the highly aggregated model are found in each of the com-



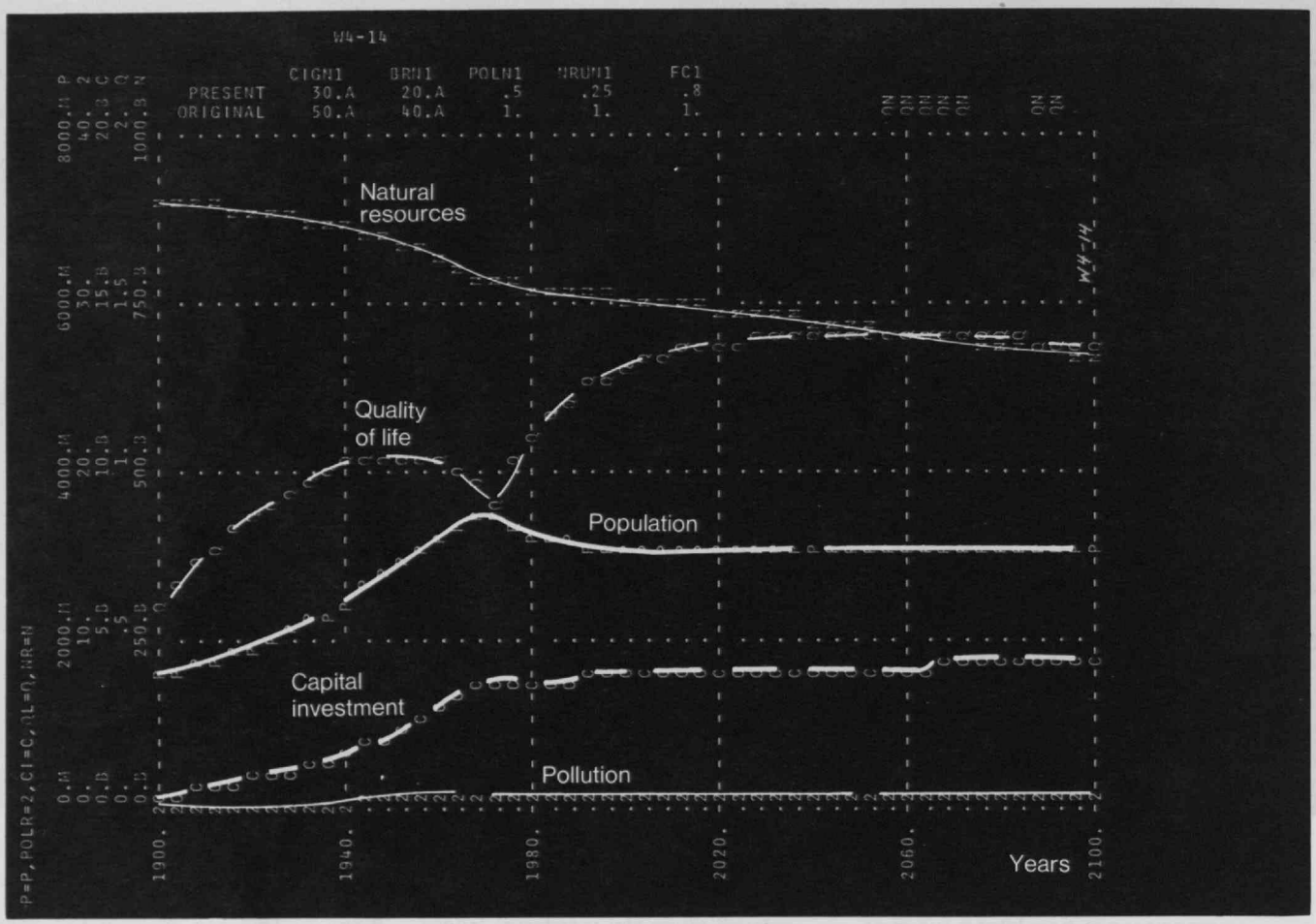
ponents of society that I listed earlier, such as the business corporation, the banking system, the labor establishment, the local, state and federal government, and the church. A dynamic model could be prepared for each subsector following the pattern of the world model, and I can visualize a hierachy of these models that could be embedded in an aggregated model of the world. Such hierarchies of models do not yet exist in sufficient number nor in sufficient depth of detail. I believe we would understand our societal system better if we had them. I urge some of my engineering colleagues to engage in the "software" development of their society, and its modelling and simulation, as they continue to produce hardware, so that the rules of the game will ultimately give mankind a world system of population, technology, and societal doctrines that will be sustainable.

Toward Implementation: Use and Improve

As education and experience at model-building evolve, we shall acquire a better understanding of the underlying dynamics of our highly interactive social system. Perhaps there will never be a time when humanity can be absolutely sure that a given policy will lead to all the hoped-for results. Decision-making under conditions of uncertainty should not, however, lead us to reject attempts to model what we now know. Policy-making and application should be based on the best information available at any given moment of history. The models we make will be better models if they are tested in the fire of events; feedback is as essential for the model-maker as for the model. Models improve as we work with them.

In the necessary collaboration of engineers and social scientists, modesty can be a useful guide. We are in an intellectual arena where asking the right questions may be more important than seeking perfect answers. Models help us do this and lead to useful information that is applicable now. For example, a complex model of the welfare system will tell us much about how we reached our present crisis; but the exercise is even more fruitful because it permits us to test alternative policies to dismantle the corrosive structure which treats the unemployed as a liability rather than as a potential asset. The model-makers will be wise to spend a few hours in the library with such philosophers as William James, Alfred North Whitehead, and Eugen Rosenstock-Huessy.

Once a model has been made, the design of new policies and structures is inevitably an interdisciplinary business. System dynamics ought to be taught in law schools, business schools, and medical schools as well as engineering schools. This will come in due course; but meanwhile we shall have to struggle forward with the imperfections of the English language as a means of elucidating the lessons, in the language of mathematics, of computer models so that all concerned can discuss and plan from a common base-line. Patience will be a common requirement, so that the step from the general statements of a model to the particular policies of a line of action is taken with rationality.



This is one of many scenarios which can be projected by Professor Forrester's "world dynamics" model: a world equilibrium to be achieved by gradually reducing consumption of natural resources and stabilizing world population and capital investment.

The technique of forming and managing interdisciplinary teams in the social sciences is in its infancy, but the public is beginning to demand "combined operations" during peace, just as military service rivalries were forcibly muted in the interest of waging an effective war. Leadership of the teams will call for discretion, diplomacy, and inventiveness.

The policy sciences may be expected to resist an imputation that their methods are incomplete and their focus misguided. System dynamics can, however, lead the social sciences away from the morass of minor preoccupations by drawing attention to the overall structure of the larger issues—and the larger systems—which embrace the future of all of us. A necessary step is the organization of study groups for the assessment of policies and institutions and for the initiation of changes that can restore health to the body politic. Unfortunately, the leverage points in the system are but dimly perceived, and the dialogue of many of the main issues has not yet been joined.

System dynamics can lead the social sciences away from the morass of minor preoccupations by drawing attention to the overall structure of the larger issues—and the larger systems—which embrace the future of all of us.

New social and environmental policies necessarily imply fundamental reappraisals of institutions and their modes of behavior. If the world is indeed approaching the limits to growth, new norms must be enunciated and new intersectoral mechanisms devised. Changes often take a quarter century; hence, we should begin now. The task cannot be accomplished by universities and research institutes alone; the search for viable structures and programs must be a shared endeavor among the institutions of research and the institutions of action. The United States, hobbled by concepts and laws derived from the very different environment of the expansive nineteenth century, must establish collaborative procedures within which leaders of government, industry, labor, finance, and research can join in the founding of the international institutions and systems of the future.

Perhaps we need a coalition of universities and industries to assess the institutional infrastructure of American society, having in mind the need to minimize pollution, depletion of resources, and congestion. Our tax laws and incentives must be recast, and, of course, the wasteful habits generated when we were a nation of pioneers in a vast wilderness must be rethought to take account of new realities. A *national commission for system dynamics and research on policy alternatives* might be a first step in providing the information needed for effective assessment of structures and policies in a time of transition and crisis.

Engineering: Instigation of Change

But the engineering schools need not wait for government or society at large to act. We can begin by reviewing a doctrine that seems to have become sacred in engineering education—that engineering students' sensitivity to social values should be achieved by exposure to humanities and social science studies. This doctrine is usually taken to mean a passive role for engineers, in which they direct their energies to producing technology that is compatible with historical and current mores and doctrines. And unfortunately, this often means an acceptance of the heavy hand of tradition and the status quo.

The issue is a deeper and more subtle one. The "software" of our social system is not in an inflexible, stationary state. The injection of technology into society has devious and powerful anthropological connotations. Just as we have found that introducing new hardware into a digital computer system necessitates changing the software for optimum performance of the computer system, so must we realize that injecting technology into the social system necessitates rewriting its "software"—changing some of the rules of the game—in some sectors of the total system.

My message is that engineers must participate in this process of rewriting "software" as they act to furnish new technology. This, in my view, changes the role of social science studies in engineering education from that of *passive acceptance* to that of *active instigation of change.* It changes the attitude that engineers must have toward societal "software." They have a responsibility and a unique set of skills in dynamics and computer modelling which can continually help make our societal "software" compatible with the "hardware" of physical existence. But they can apply these skills only if they broaden horizons.

Acknowledgement

The author is grateful to his colleagues, Professor Jay W. Forrester and Dr. Frank P. Davidson, for their helpful contributions to the substance of this paper.

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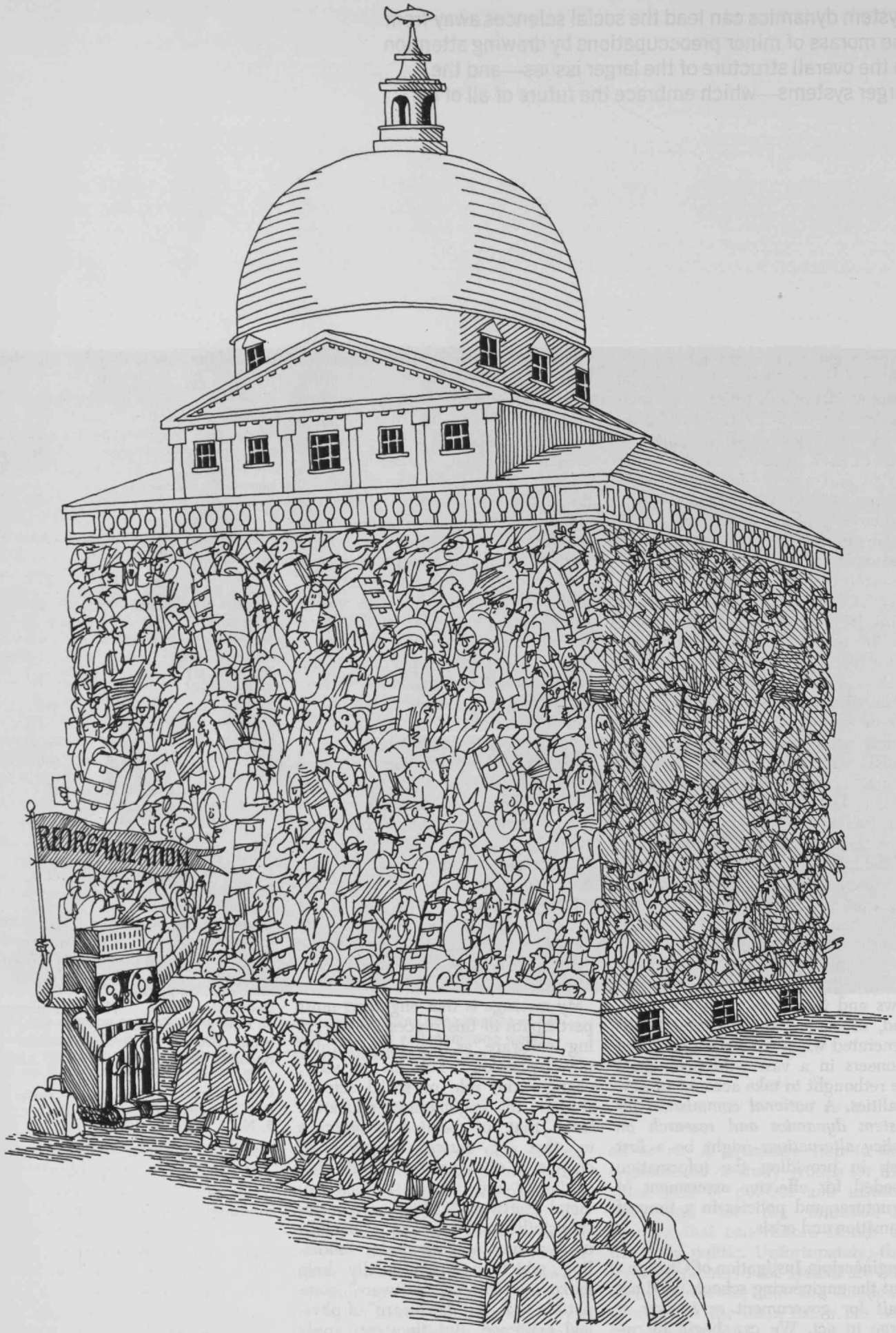
REORGANIZATION

Robert C. Casselman

The State of State Management

Everybody's problems now assemble at the state capitol. Here is how a management system to keep track of benefits and costs was commissioned, proved—and rejected by Massachusetts. Could it have been otherwise?

Though national events of an election year tend to divert attention from state governments, the fact is that after decades of languid functioning between local and national authorities they have experienced a recent and dramatic insertion into society's most difficult problems.

State governments have been put in their present positions of increasing stress partly by local communities and partly by Washington. The states have won by default the leadership role in most of our major domestic problems—waste disposal, transportation, poverty, crime, health and dozens more—and they appear to be doomed to hold it for a long time to come. Many municipalities are near bankruptcy, and the federal government's omniscience and inexhaustible bankroll have turned out to be myths. The problems have no place else to go. There can be no turning back.

The history of all state governments for the past 10 or 15 years is the same: very rapid growth in spending and taxation, accompanied by a steadily building pile of unresolved problems lying on the capitol steps. During this period the total of state spending has risen more than threefold, and the curves of cost and taxes are still pointing skyward. State government has become the boomingest growth enterprise in America. Unhappily, there seems little correspondence between increases in spending and amelioration of the problems, and therein lies the real issue that the states face as they ride toward what may become a genuine crisis in government.

The states must now learn, and quickly, what the local and federal levels have as yet been unable to learn: how to manage their huge and complex enterprises to gain a more reasonable balance between resources expended and results achieved.

This is a very difficult management matter, for which the states are ill-equipped. They face their new burdens with a set of traditions, management styles and operating skills that largely belong to a bygone era. To all the complexities of managing large private enterprise must be added some monumental complexities found only in government: the transitory nature of the top administration; the rigidities imposed on personnel deployment by civil service and employment restrictions; the ever-present fact of political patronage; the fish-bowl environment that the press exploits in its urge to report conflict rather than accomplishment. Only one who has been in government can know how frustrating and enervating those can be, and it is all too easy to weary of the struggle and conclude that nothing fundamental can be done to turn these governments around.

But I think there can be hope, and I base that hope on an experience in one large government that came very close to making a genuine break-through in its management style and approach.

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Finding the Pebbles in the Governor's Shoe

Five years ago I was invited by then-Governor John A. Volpe to join in an effort to streamline the government of the Commonwealth of Massachusetts and bring it under more responsive control. That state's government is quite typical of all governments of size, though it is not the biggest state government by far. During my work I came to know a good deal about many other state governments, and I assure that for Massachusetts you may read Connecticut or California or North Carolina or wherever you happen to live.

The Governor's charge was to recommend ways to shape up the Executive Branch, which spends almost all of the money, to make it more responsive to him as Chief Executive and more accountable for what it was and was not doing. Here was a dream assignment—plenty of time, adequate funds for staff, unrestricted access anywhere, and no operational burdens. We were invited to come in and study, and learn, and think, and finally to recommend and help implement change.

Massachusetts, with only 60,000 employees and a budget of $2 billion, is still small enough to get one's arms around in a year or two of reconnaissance. (New York City's Police Department alone compares pretty well with those numbers.) But Massachusetts' government spending had tripled in little over ten years, and if trends continue it will double in size (and in revenue needs) in another five.

Within this ballooning enterprise there existed over 300 statutorily-created administrative entities, over two-thirds of which reported directly to the Governor himself. This patently insane managerial arrangement reflects government's traditional answer to any problem: create a new agency to handle it. (Mas-

The issue is not whether today's system of authority from the top down is a source of corruption. The issue is that exercise of such power destroys management vitality throughout the enterprise.

sachusetts is by no means the leader in this field; the State of Utah, which started a couple of centuries behind us, was several dozen agencies ahead when I last looked.)

The welter of agencies was only the most visible evidence of some deep-seated management problems, but it was clearly the principal pebble in the Governor's shoe. Not only did very little happen when he pushed buttons; frequently it was next to impossible to find the right button to push. At the very least he wanted to be better able to find out what his agencies were up to and hold them accountable for their performance.

Anyone who has banged around in the management world for a while has learned that organizational form is only one factor, sometimes a very small one, in the mix that determines organizational vitality. So, though "reorganization" was the name of our assignment, the far more difficult task implicit in it was to discover what else might have to be done to give any improved structure some hope of performing better than the old. (Charlie Brown made that point unforgettably when he concluded that his Peanuts baseball team was all set to play once he had the players assigned to positions.)

The View from the Inside

In order to look well beyond the tangled structure, we built a staff that included some systems and management people and several people with political experience to keep us in touch with reality. In all, we spent about fifty man-years in study and in new system development.

Let me picture for you the chain of management illogic that we traced—one that handcuffs government's ability to perform and that renders it incapable of meeting mounting problems except by spending more money.

The chain began with the premise, assuredly unchanged in Massachusetts since the days of George III, that all decisions must be made at the top. Not just the big decisions about the directions in which government shall go, but the thousands of small decisions needed to take it there. The "top" in government was presumed to be the Governor and the Legislature, the former proposing, the latter disposing, the former administering, the latter enabling through statute and appropriation.

That's the way they teach it in the civics courses, but that's not the way it works. The Governor can and does ignore legislative intent; the Legislature does directly control administrative practice and policy by the way it uses the purse strings (and regularly violates the Constitution in so doing). There is in fact no single "top," yet the management philosophy of government is still rooted in the Georgian principle: the king rules. (Some of us have wished that he still did. "Off with their heads" adds great persuasion to any argument.)

Contrast this hoary philosophy with the one that pervades all successful large enterprise today. Alfred P. Sloan, Jr., articulated it in describing the growth of General Motors (and I know that one cites that organization as a model at some peril): Decisions should be taken at the lowest possible level capable of dealing with the problems. That philosophy vests the decision-makers down the line with both the authority to make decisions and the responsibility for their outcomes, and it also requires that there exist clearly enunciated policies and detailed operating plans to guide such decisions.

The task of top management in this kind of philosophy is to establish policies, review and approve operating plans, and use such control and information systems as are necessary to learn when operations deviate significantly from those plans and policies.

Government has never embraced this kind of management philosophy. It has instead hammered out all the links in the chain that its autocratic style requires to lash the whole leaky vessel together. The wonder is not that the ship of state doesn't sail better but that it stays afloat at all.

One of the most difficult spots in that chain belongs to the manager charged with operating an administrative agency, large or small. He seems to be everyone's whipping boy, a man who owes his job to whom he knows rather than to what he can do, a man content with inaction, bent on security, and perhaps even a little corrupt. I freely confess to holding something like this notion, before I entered government. More politely stated, the popular view is that the basic thing wrong with government is the people in it. I no longer believe that to be true.

In the Massachusetts case (and I suspect in the case of all other big governments) people-quality is not the real problem. Survival instincts of government employees are too well honed; positions are too well protected by civil service; employee unions have become too powerful. We must take the people as they are, and in Massachusetts we discovered that they are—potentially—pretty good. One finds considerable numbers of public administrators who are not only well-informed

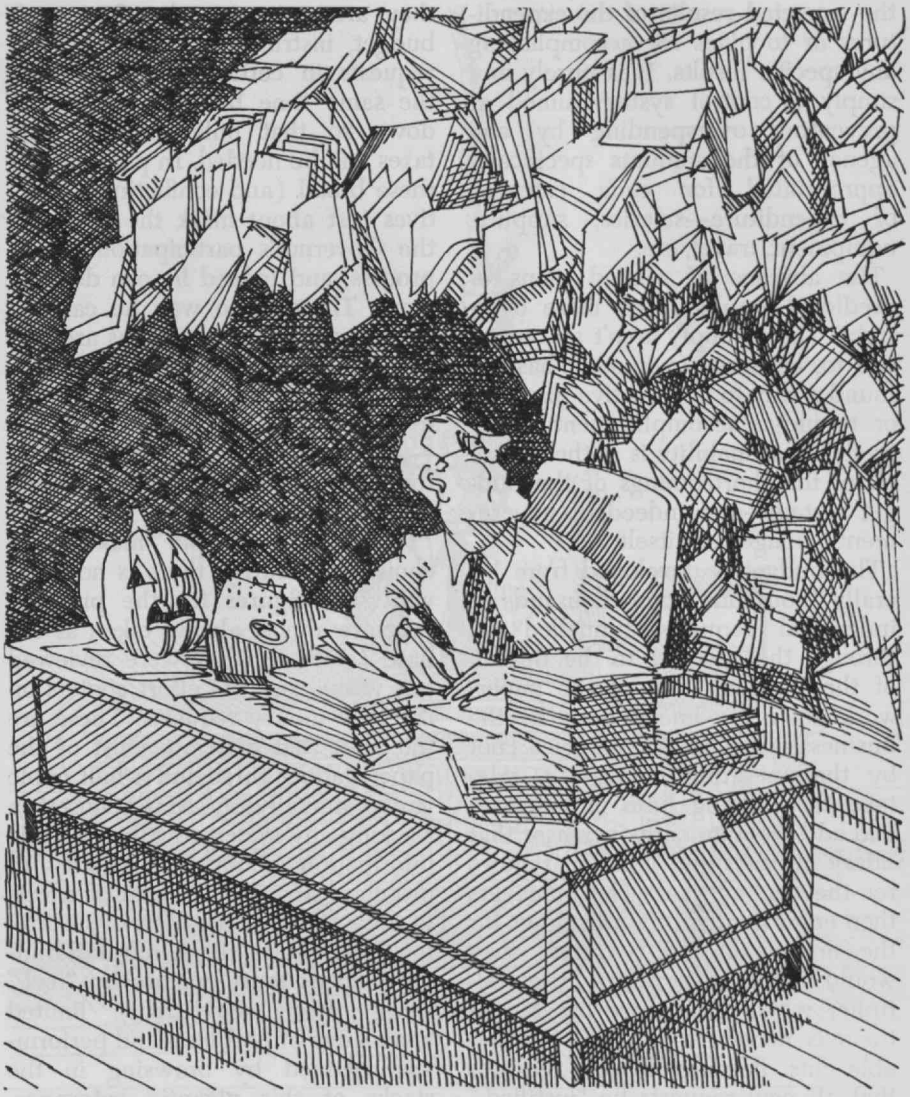
about their jobs but who demonstrate some desire to see them go better. They very much resemble their industrial counterparts, sharing most of the same needs for accomplishment and the same frustrations of working life. Misfits and incompetents are by no means commonplace.

What is commonplace is a gross failure of government to tap the latent talent and commitment that is there. Indeed, government not only ignores it but submerges it in monumentally frustrating red-tape and picky intrusions into inconsequential detail. Item: in Massachusetts the top administrative officer next to the Governor must add his own signature to ten others required for approval of a $5 travel voucher. Most managers spend most of their time fighting a system that affronts their competence and honesty several times a day.

If You Would Shape Government, Shape the Budget

Most devasting to the development of managerial capability is the almost complete exclusion of managers from the decision process that determines what moneys shall be spent to accomplish what results. That process is encapsulated in the budget system, and there one can read the scenario that describes what government management is all about. If you would learn about government, learn about the system it uses to spend your money. If you would change government, begin here.

In Massachusetts and in almost every other state, "the budget" is the total of thousands of items for which the state plans to spend money—and that's about all. It does not contain, nor does it anywhere refer to,



Though Massachusetts is small in area and in population, its problems are not different from those of other states: despite rapid growth in personnel, spending, and taxation, there remain behind the Governor a steadily increasing pile of unresolved problems. Caught in this onslaught and rendered largely impotent by his responsibility for more functions than he could possibly supervise, the Governor of Massachusetts in 1968 asked the author to lead an effort to streamline the state's government. The plan was far more than the "reorganization" under whose banner it was generally discussed. (Illustrations by Dill Cole)

Managers in state government have been well conditioned to keep their guard up. But in the author's plans they saw a hope for a new day in which the rules favor them instead of the little inside group that now makes managers' lives so miserable.

the expected results of the expenditures or to plans for accomplishing any specific results. It is purely and simply a control system aimed at preventing overspending by any agency of the amounts specifically appropriated for each category of expenditure—salaries, supplies, equipment, travel, etc.

The absence of related plans or predicted results is no mere oversight. There simply aren't any to relate to, because government has not found a way to do effective planning or to judge accomplishment objectively. That inability is at the root of all of the shortcomings of the budget system—and indeed of government management itself.

The budget is developed from literally thousands upon thousands of individual requests funnelled up through the agencies to the Bureau of the Budget. Most of the paperwork down the line is done by the business offices in the agencies (not by the operating managers), who take the existing base of expenses and add the automatic increases that salary changes and inflation require for the coming year. The managers then enter their special pleadings for the new staff and resources they would like to have, plus a little multiplier which experience has taught them is necessary to offset predictable cuts. Because the law requires that all new requests be "justified," volumes of prose accompany the budget submissions. Thus a Niagara of paper floods the Bureau of the Budget every October.

The process acquires a genuine secrecy simply because of the scale of this torrent of pastel forms. From them a handful of budget examiners and their chiefs must pick which requests shall be granted, which reduced, and which denied. In theory, they are preparing the Governor's budget, instructed by him to favor requests in certain fields while at the same time holding the budget down so that only minimal new taxes will be needed. In point of fact these broad (and conflicting) directives just about mark the extent of the Governor's participation in the process, and indeed he can do little more. There is no way he can tell which agencies or programs are performing ineffectively and which have become less important relative to new tasks which need doing. He —and everybody else—can see only the new needs, not the continuing failures.

The budget people make their choices arbitrarily; there is no other way. The figures for the previous year are almost always taken as the base (after all, they were reviewed last year), and the effort centers on the new money requests. These are the ones that generate most of the paper (about three and a half cubic yards annually, in Massachusetts). Lacking any systematically available information about the severity of problems, the effectiveness of efforts to solve them, or the costs of sustaining those efforts, this handful of budget officials must operate by "feel," using their unavoidably limited knowledge of problems and performance gained by browsing in the stacks of this gigantic enterprise. Pressures for favored treatment abound, and they are by no means ignored. Personalities and politics play an understandably large role in this essentially nonrational process; the budget decision can punish as well as reward.

Once this amalgam of little decisions called The Budget has been put together by the inside group, it is submitted by the Governor to the Legislature for enactment. The same kind of review process is repeated, this time by the legislators and staff of the Ways and Means Committees of the House and Senate.

Once more, the key decisions are made by a small and select goup of people who are supplied with the very same uninformative detail that underlay the construction of the budget by the Executive. Once again, there can be no review based on accurate and systematic knowledge of problems and accomplishments. The review concentrates on the increases, not the base; and once again the utility of the budget as a means of reward or punishment is not overlooked.

The legislators who must ultimately vote on the budget are almost as much in the dark as the ordinary citizen about most of the items in it, because there is simply no way to learn from the document itself just why the money is needed and what it will buy. Some legislators make a special effort to learn about a few items in detail (typically the ones for which they are interested in securing more money); but even in these cases their information is severely limited. They must vote, and they do, making their separate contribution to the steady upward spiral.

In this fashion do governments reach the thousands of small decisions which together constitute the commitment that the taxpayer is called upon to meet. It is not surprising that spending can only grow larger. It is not surprising that performance evaluation has no place in the process, because there are no plans developed against which to make any evaluations.

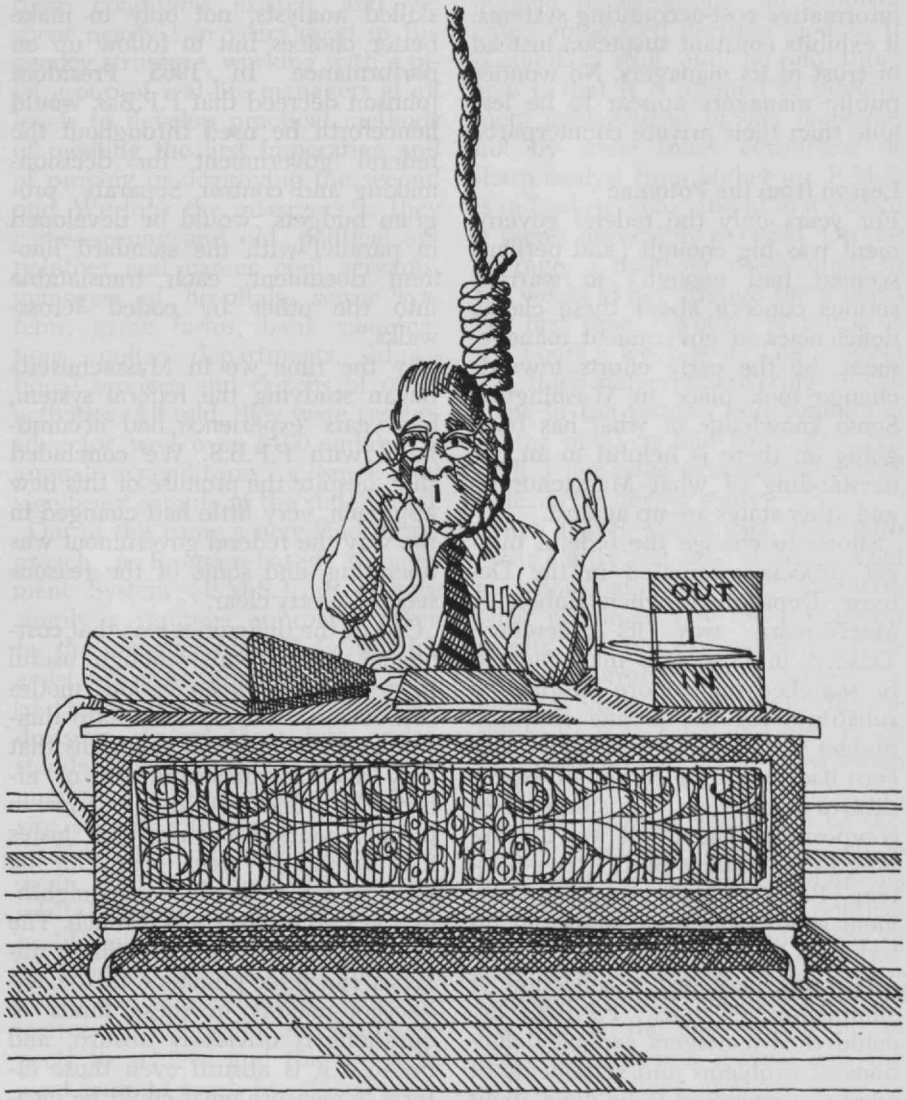
What *is* surprising when one gets deeply inside government is the al-

most absolute power that the system vests in the Budget Bureau and Ways and Means personnel. Whether such power corrupts is not the issue; the issue—and the fact—is that exercise of such power destroys management vitality throughout the enterprise.

In the Massachusetts case, the budget system and the archaic philosophy which it preserves became the principal target of our efforts toward reform.

Solutions are by no means as simple as might appear to managers who are experienced only in corporate management, who would instinctively press for downward delegation of responsibility and authority. Private enterprise has one vital element stitched into its every fabric which is lacking in government: a continuous market-place evaluation which reaches into every corner of the organization through the profit-and-loss statement and its attendant cost controls. Private enterprise can trust its managers to plan and to perform against a plan because both the plan and the performance can be readily monitored —ultimately by the cash register. The techniques and information systems required for this monitoring and evaluation are well developed. Their presence is an accepted fact, the reward system is based on them, and managers respond to them. Acceptance of responsibility down the line is encouraged, and trust in the managers is a fact of life.

It cannot work that way in government simply because there is no marketplace, no cash register keeping score with a ruthless certainty. Lacking this built-in check, government has substituted tight choke collars for loose tethers on its managers; it relies on picky audits rather than on



Five years later the Governor of Massachusetts is still throttled by more responsibilities than he can manage, and the forces of "reorganization" have retreated because their mission was never understood. The problem, writes the author, is that enterprise management is not among the skills upon which voters base their choice of Governor. As the management team leaves the State House to its continuing well-intentioned frustration (see page 39,) the author hopes they leave behind at least one message: "There can be another way to run big government: one that taps the talent that is latent there and builds upon it the managerial competence so sorely needed."

P.M.S.: define problems, establish objectives, identify actions, price programs, and define the measures of success—standard stuff, except when applied to government management by the manager himself.

informative cost-accounting systems; it exhibits constant suspicion instead of trust of its managers. No wonder public managers appear to be less able than their private counterparts.

Lesson from the Potomac

For years only the federal government was big enough (and perhaps seemed bad enough) to warrant serious concern about these classic deficiencies in government management. So the early efforts towards change took place in Washington. Some knowledge of what has been going on there is helpful to an understanding of what Massachusetts and other states are up against.

Efforts to change the federal budget process originated in the Defense Department when Robert S. MacNamara was its Secretary. Trained in corporate management, he searched for a more informative substitute for the arcane line-item budget system—one that would concern itself with the results of expenditures rather than with simply their composition. The result was a Planning-Programming-Budgeting-System (P.P.B.S.) that viewed government as an array of separate but interlinked service businesses called "programs," not just a collection of administrative units. P.P.B.S. demanded of managers explicit definitions of problems and statements of what was proposed to be done about them, what costs would be, and what new results could be expected. Some extraordinarily sophisticated analytic techniques were developed to weigh alternative approaches.

The MacNamara system had a powerful rational appeal; it promised to substitute for the missing marketplace an objective balancing of measurable benefits against costs, enabling decision-makers, aided by skilled analysts, not only to make better choices but to follow up on performance. In 1965 President Johnson decreed that P.P.B.S. would henceforth be used throughout the federal government for decision-making and control. Separate "program budgets" would be developed in parallel with the standard line-item document, each translatable into the other by coded "crosswalks."

By the time we in Massachusetts began studying the federal system, five years' experience had accumulated with P.P.B.S. We concluded that, despite the promise of this new approach, very little had changed in the way the federal government was operating, and some of the reasons seemed pretty clear.

One of the difficulties was that cost-benefit comparisons—though useful in deciding between various modes of nuclear strike delivery—are difficult to make in social programs that defy accurate measurement of effects. No one yet knows how to place a value on water that tastes like water, or trees that can be seen by poor people, or an eighth-grader's ability to speak French. The presumption that even brilliant analysis can offer guidance to the top decision-makers in these kinds of questions is obviously absurd, and because it is absurd even those efforts to measure what could be measured were often swept out in the tide of criticism of P.P.B.S.

P.P.B.S. also fell into another trap that seriously compromised its ability to improve federal management: It did not eliminate the isolation of down-the-line managers from the decisions which affected them so importantly. Indeed, it accentuated the heavy-handed top-down approach by its reliance on external analysis of program problems and performance. More often than not these analyses were performed by "whiz kids" from top staff offices who were viewed more often as adversaries than as allies. Bright and perceptive as they were, these analysts in no way represented the help that the managers needed.

The response of the federal bureaucracy to P.P.B.S. has been fairly predictable, given the remarkable survival instincts of government people. It seems to go something like this: "Tell us what you want to be told, and you shall be told it. If program budgeting requires a new format and more eloquent justifications, you shall have them. If you want us to measure that which cannot be measured, we shall measure it; and we'll even employ our computers to drown you in data. But don't forget for a minute that we're closer to the action than you are, that we generate and control the data, and that we can play games with your analysts that they can never win."

Program budgeting has undoubtedly been of help to some of the top decision-makers in Washington, but it has by no means brought the far-reaching changes that were hoped for. The management style is still heavily top-down, budget decisions still have much of the arbitrariness and exclusionary secrecy of the old system, and the increment rather than the base receives most of the review effort. The manager down the line not only experiences little new feeling of being involved or trusted, but rather finds himself on the receiving end of a new order of intense and critical analysis. His defenses appear to be equal to the occasion.

I freely confess that this view

emerges from the acutely perceptive hindsight afforded an observer who can nose around in someone else's troubled camps and talk to the walking wounded. When we began our efforts to overhaul the budget process in Massachusetts, we were quite committed to the P.P.B.S. approach, and the reconnaissance we performed in the federal government and elsewhere was directed primarily toward shaping that system for the state's needs and avoiding some of the methodological pitfalls that seemed evident in the pioneer efforts. But somewhere along the line it dawned on us that we were viewing the problem in largely cosmetic terms. We pulled up short and then went at the heart of the matter. It is there that Massachusetts began to plow new ground.

The New Slant, and a Discovery

The approach Massachusetts ultimately developed was based on the perhaps fatalistic assumption that, since the present top-down rule seems not to work, and since the face of the bureaucracy is not likely to change, much of the hope for better management must lie in the typical managers that government already has in such large numbers. It followed that, at the very least, these managers must be genuinely supportive of any new approach; and, since they are human beings, we arrived at the first imperative: there must be something in it for them.

The second imperative, if the hope for improvement is to be fulfilled, is that these typical managers have at least a latent desire to perform better and some inherent capability to do so if given a chance.

We set out to devise an approach and a system which could tell us if these conditions existed, and we spent nearly two years deep in the agency structure, working with a pilot group of real-life managers at all levels to develop practical methods of meeting the first imperative and of proving or disproving the second one. We took the managers as they came—young and old, political appointees and career civil servants, managers of hospitals, sewer systems, game farms, bank examinations, police departments, educational services and dozens of other activities. All told, they were responsible for well over $100 million in annual expenditures, a small but significant sample of the state's total.

Out of this came a new kind of approach, a Program-based Management System (P.M.S.), in essence simply a rigorous approach, *taken by the manager himself* (with such assistance as he requires) to:

☐ Define the problems he is addressing, dissect them into understandable components, and put hard numbers on them to describe their size, severity and trends.

☐ Establish specific objectives, again with hard numbers, showing what he proposes to do about the problems.

☐ Identify the activities he must undertake to accomplish those objectives, including the outputs he expects to achieve and the levels he must have to reach his objectives.

☐ Price the activities, in both existing and new resources, and thus derive a cost of fulfilling each objective.

☐ Define how achievement of the objectives will be gauged, and how the impact of the achievement on the problems will be measured or sensed.

There is nothing occult in this—no breakthrough in management method or technique, no sophisticated automated decision models. It is standard stuff, and the only thing new is that it is applied to government management *by the manager,* not by some smart consultant or sharp analyst from higher up. P.M.S. is indeed rigorous, and at first glance it seems impossibly detailed. On the average, a manager needs eight to ten weeks to get through the process the first time, devoting as much as ten hours a week to it. The product is a thick statement covering all the steps in the process and containing all the numbers and costs, prefaced with a five-page summary and well indexed for deeper study.

Such P.M.S. statements show with great clarity just who is doing what to whom, at what cost, and with what presumed (by the managers) results. The process makes the manager responsible for a well-documented view of the problems he thinks he is to solve and how much he thinks he can do for how much money.

Where program results can be distinctly measured, they are; where they can't be, the value judgments remain to be made by the political system—but with full knowledge of cost and objectives. The P.M.S. statements force accountability all the way up the line—at the top, to make hard choices of what will and will not be done; at the bottom, to achieve the expectations to which the manager is committed—and no others.

The budget requests that flow out of a P.M.S. approach are all tied very precisely to a promised level of performance that can be readily monitored and easily changed and updated. A budget system based on P.M.S. *requires* that a governor and his top administrators become fami-

liar with current and proposed program costs and results, and they must—and can—make the difficult choices of what will and will not be done. The manager and the administration jointly arrive at a contract which holds no surprises. If the manager fails to deliver what he said he would, the failure cannot be charged to the system, as at present. P.M.S. shows with merciless clarity if the manager is myopic, or careless with the figures, or simply incompetent. The clarity stems from the methodology, which is detailed, intricate and highly revealing; the process works in daylight, not in secrecy.

What of the manager's response? I now know that latent commitment and motivation to accomplishment are there in the large majority of the managers. Many could not be called good managers in any sophisticated sense. Most had only government experience, and in government one copes—not manages.

Those we worked with were initially defensive and suspicious of reformers, for they have been well conditioned to keep their guard up. But they are people with real problems, not the least of which is a need for understanding and support, and when they began to sense that such might be forthcoming they responded. Planning, pricing, controlling and evaluating in any systematic way were foreign to them simply because they had never been called upon to do them. With a few exceptions they learned quickly enough—some of them very well indeed; their classroom was their desk and their homework was their job. We held no training sessions, gave no lectures or assignments. We just worked together, one on one, to try to identify problems and find a way of looking at and dealing with them as fully experienced and trained managers might.

Why did the managers hold still for this complicated and purely voluntary exercise? They will tell you that they saw in it a hope for a new day in which the rules favor them instead of the little inside group that now makes managers' lives so miserable. P.M.S. offered them a chance to be explicit about what they could and could not accomplish at any given level of funding. They recognize that there will never be enough money to go around, and they want choices made on the basis of what the probable results will be. They recognize that P.M.S. is an extremely revealing process which increases their vulnerability to criticism for poor management. But they are tired of being publicly chastised for failing to meet problems because of arbitrary budget cuts on which they had no influence.

I have referred to the managers as though they were one group giving a homogeneous response to the new approach, and I should soften that impression. There are ardent champions of P.M.S. at one extreme; there were also three managers out of nearly 50 who dropped out somewhere along the line. The quality of the individual statements was uneven, reflecting varying levels of commitment, time and understanding. Some of the managers probably should not be managers at all; they would not survive in an environment based on P.M.S. Others showed exceedingly high aptitude and would have been successful managers in private enterprise, had they aimed in that direction.

On the basis of our experience, I believe one may hope that government can in time be shaped into a more responsive and effective enterprise, using just the materials it has available.

But not in Massachusetts, at least for some time to come. We didn't make it there, and the reasons we failed are worth relating, for they carry a useful message to other governments who are seeking a new day.

Manuals, Reports, and Wistful Memories

Earlier I noted that our primary assignment was to bring about a reorganization of the thicket of agencies that so plagued the Governor. That word "reorganization" proved to be part of our undoing, because it obscured the much more complex task of altering the management philosophy and system in the way that I have just described. It became the only term used to describe this ambitious effort, and from the beginning that word shaped everyone's vision of what this was all about. To the press and the public "reorganization" meant heads rolling and agencies plowed under, a cathartic upheaval that would render this government lean and responsive to the bark of command, just the way big corporations are in the movies.

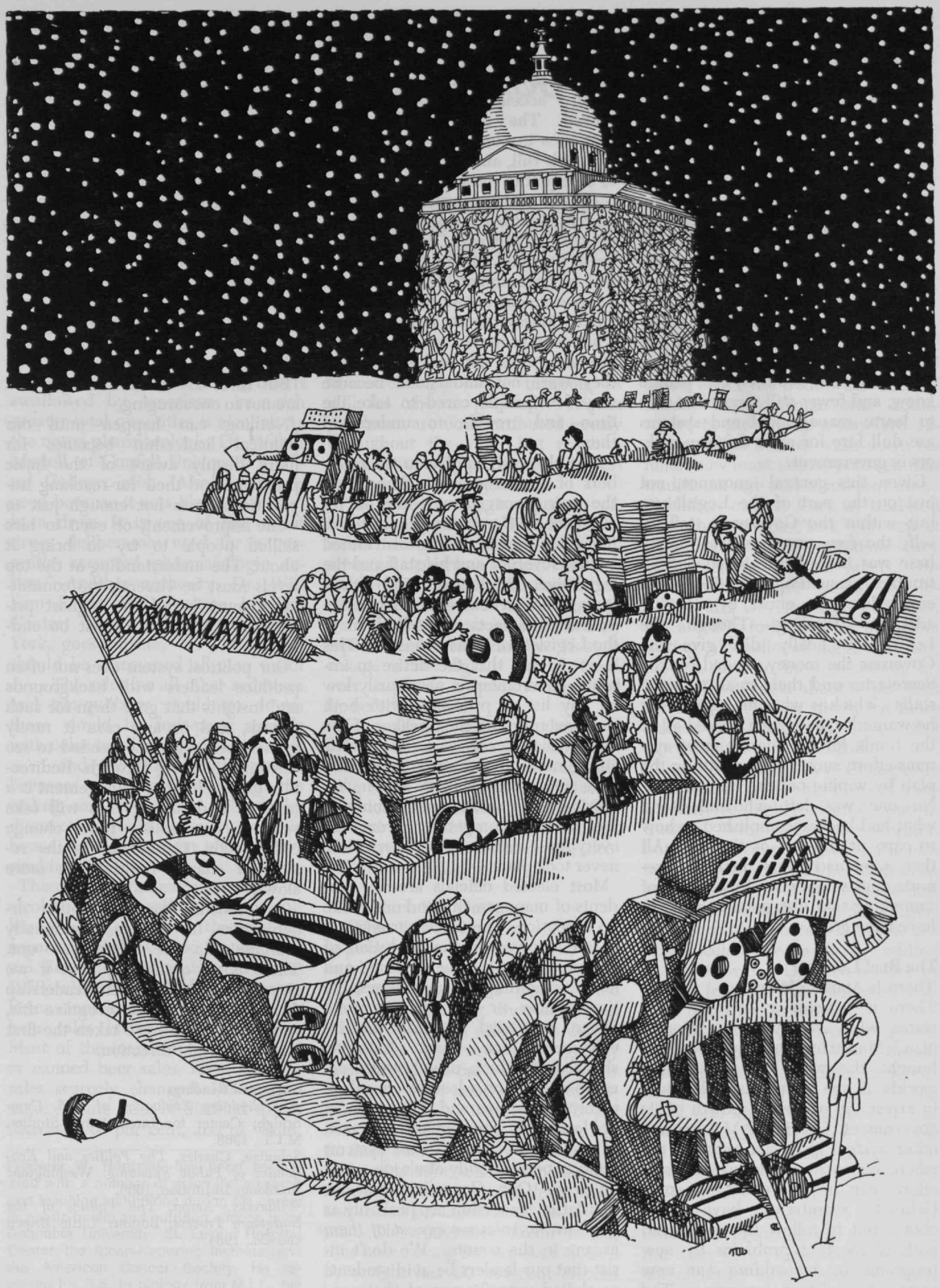
All of us close to the scene knew that this was nonsense, that structural changes alone would not suffice. But we also knew that the needed new management approaches could not possibly be implemented without a powerful structure committed to them.

We therefore proposed, and there was enacted into law, a new Governor's Cabinet of ten administrators, each in charge of a separate functional area (transportation, education, environment, etc.). Every existing agency was placed under one of these new Cabinet Secretaries, who had the power of the budget and was instructed by law to work on new and better management methods as well as on improvements in organizational structures.

The Cabinet Act would not have been passed at all had not a few of the legislative leaders taken the trouble to inquire into the other half of what we were proposing—the change in management approach. They were as skeptical as we about the likelihood of a new layer of administration being able to turn this government around all by itself. But the new systems excited them sufficiently to win their support for the effort, and the Cabinet Act went through with ease—though only a handful of legislators understood what the whole thing was about at the time.

The "go" date was set 20 months away to allow time for pilot testing of P.M.S., assembling a nucleus of staff to install P.M.S. for the Cabinet Secretaries, and recruiting outstanding candidates for the new top positions. The only remaining need was an initial appropriation to pay the salaries of the Secretaries and to create the systems staff of about 70 people. The total cost for the first year was to be roughly $1 million in new money—0.05 per cent of the current $2 billion budget, just about equal to the Legislature's annual printing bill.

But 1971, when this question came up for decision was not a good year for better government. Times were hard. The Governor's request for funds sparked a political brawl in the best Massachusetts tradition, with Republican Governor Francis W. Sargent (Volpe's successor) pitted against an overwhelmingly Democratic legislature. The issues quickly became jobs and money—


REORGANIZATION

Cabinet Secretaries' jobs which looked like too much lush patronage for a governor at salaries ($32,000 to $37,500) which looked pretty high to legislators making less than a third as much. As the battle mounted, the Governor complained publicly and bitterly that "reorganization" (his standard term for it) was in peril. The legislators responded with spirited charges that the whole thing was a waste of money anyway because 10 new people couldn't possibly do what 60,000 employees were already failing to do. At no time in the eight-month debate was there a concerted effort to explain what the complete plan was all about. Few people knew, and fewer still seemed to care to learn; management and systems are dull fare for most decision-makers in government.

Given this general ignorance, not just on the part of the Legislature but within the Governor's staff itself, the few people whose power base was indeed threatened had no trouble persuading the House to emasculate the effort by denying adequate funding. Though the Legislature finally did give the Governor the money needed for the Secretaries and their small personal staffs (which is what he kept saying he wanted), the House excised all of the funds for the management systems effort, successfully scuttling the plan by wiping out the trained staff. No one was left who understood what had been accomplished or how to carry it the rest of the way. All that remained were manuals, reports, and some wistful memories of something that was good and might have been great.

The Real Lesson: There Is Another Way

There is a warning here to other states who are trying to "reorganize." Massachusetts may well have bought the worst of all possible worlds, if one of its basic aims was to arrest the explosive growth of its government. Lacking P.M.S. or any other system that can reliably tell where retrenchment is possible and efforts can be redirected, the new Cabinet Secretaries have little choice but to follow the traditional path of meeting problems by new programs or by adding (at new costs) to existing programs. The Secretaries, because of their greater prestige and visibility, can become much more powerful advocates of increased spending than their fragmented agencies ever were, and one can already sense that spending is being accelerated rather than slowed. The small inside group that tries to control the budget has its hands full, and it does not appear to be equal to the now greater task.

"Politics" is the reason most observers cite for the failure of Massachusetts' grand plan. But that word doesn't explain anything. Politics is a fact of government life, and anyone in government knows that before he enters. Massachusetts failed because what was proposed, and what was at stake, were not understood; and they were not understood because very few people cared to take the time and trouble to understand them.

That obviously applies to the members of the Legislature who voted the new management effort out of existence on the wrong grounds. But this blame must also be distributed to the Governor and his staff and the legislative leadership and their staffs, all of whom were in position to learn the facts and tell them to the Legislature if they chose to. This is not to say that the desire to improve government is necessarily low on any list of priorities; with both the Governor and the Speaker of the House that desire was deep-seated and genuine. But translation of that wish into well-planned action, requiring some study and learning in the face of competition from the everyday crises of government, never took place.

Most elected officials are not students of management, and ours were no exception. The Governor was not at all involved in the evolution of the new management systems, and he knew nothing of the changes, the time frames or the staff required. When we tried to gain his involvement, we were routinely shunted elsewhere, usually to the accompaniment of a lecture on gubernatorial pressures and duties, aimed at lessening our obvious naivete. Management concepts and systems seem to be somebody else's job.

Agreed. Our Governor and our legislative leadership are probably as good *in the roles we expect of them* as any in the country. We don't insist that our leaders be avid students or skilled practitioners of the management of large enterprise, and by and large they are not. This fact, coupled with the transitory nature of their typical service, makes it extremely difficult to accomplish the deep-seated, long-term change needed if state government is to do better than it is now doing.

The Massachusetts efforts carries many messages. I would like to think that the most important one will not be lost: that there can be another way to run big government, one that taps the talent that is latent there and builds upon it the managerial competence so sorely needed. I firmly believe it can be done if we can find a way to loosen up the tethers and show some faint signs of trust.

But there are other messages that are not so encouraging.

Nothing can happen until our political leadership becomes far more deeply aware of the basic problems and their far-reaching implications. It is not enough just to want improvement, or even to hire skilled people to try to bring it about. The understanding at the top levels must be visceral, the commitment must be of the highest priority, the persistence must be endless.

Our political system does not often produce leaders with backgrounds and insights that gear them for such a task, and in any case it rarely grants them the time needed to see this kind of thing through. Redirection of government management is a massive undertaking that will take years to accomplish. Roles change only slowly. Confidence in the results of change builds even more slowly.

Government, like every other organization in trouble, continually searches for the quick way out. There is no quick way, but if we citizens and our political leadership do nothing more than recognize this, we shall at least have taken the first step in the right direction.

Suggested Readings

A Preliminary Evaluation of PPB. Cambridge: Center for International Studies, M.I.T., 1968.

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Wildavsky, Aaron, *The Politics of the Budgetary Process.* Boston: Little Brown and Co., 1964.

Frederic W. Nordsiek
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Alcohol: a Medicine and a Food

One of the oldest of our drugs is surprisingly versatile and valuable. We continue to study how it works and how we respond to it, but the problem of addiction is still a serious one.

Aspirin is only the second most widely used medicine; a drug that is swallowed by Americans in much greater total quantities is alcohol. As the noted pharmacologist Dr. Walter Modell, of Cornell University Medical College, said, "Alcohol . . . is used because it acts like, and in fact is, a drug. It is one of the oldest drugs deliberately used for a currently accepted pharmacologic action." Another authority, Dr. William Dock of Downstate Medical Center, State University of New York, goes further, ". . . if alcohol should be discovered all over again . . . . The sales for all other sedatives and tranquilizers would go down; there would be four-page spreads with color in all the medical journals . . . and the stock of the patent licensees would go right through the ceiling on Wall Street. The lucky discoverers would get every possible honor, as did the men who discovered insulin."

The steadily increasing amount of alcohol that descends American gullets may be followed through tax reports from the United States Internal Revenue Service. From 1960 to 1970, while the United States population increased but 12 per cent, beer sales increased 39 per cent. Most of the increase was in bottled or canned beer sales, for draft beer sales scarcely changed. During the same decade sales of distilled spirits increased 60 per cent, and of wines, 64 per cent. All this was in the face of increasingly heavy taxation, as will be shown presently. Liquor purchases are not distributed evenly throughout the year, but reach a sharp seasonal peak during the festive month of December.

The sedative and tranquilizer effects of alcohol that Dr. Dock alluded to constitute the ". . . currently accepted pharmacological action" cited by Dr. Modell. This comforting effect of alcohol is rapid though transitory, but may be sustained by repeated moderate dosage. If such dosage is not rigidly limited, however, euphoria is quickly succeeded by befuddlement.

Like all active drugs, alcohol is poisonous in excessive amounts—even the benign aspirin can kill. Like some other medicines, alcohol produces "side effects," i.e., incidental and undesirable actions. Finally, like certain other useful drugs, alcohol can be addicting.

How Much You Get In What You Drink

Aspirin labels tell you plainly how much to swallow and how often; and each pill contains a rigidly fixed amount of the drug. But the correct dose of alcohol is difficult to define.

Alcoholic beverages vary greatly in strength: all the way from beers at about 4 per cent alcohol to distilled liquors having up to 75 per cent. To confuse the imbiber still further, beer alcohol is measured in terms of weight, whereas the alcohol in spirits and in wines is determined and stated on labels in terms of volume. The conversion factor is 0.8; thus beer having 3.2 per cent alcohol by weight has 4.0 per cent alcohol by volume. Serving units are also inconsistent. Many bars use "shot" measures of one ounce, some use "jiggers" of an ounce and a half, still others entice the trade with "double" drinks. The workman once accustomed to picking up a standard 12-ounce can of beer to wash down his lunch now must choose between that traditional size and a one-pint unit.

Imbibers of beer learn by trial and error how much "kick" to expect from their chosen potation; they can't even guess from labels. Obviously draft beer cannot be labelled, and labels of cans or bottles are actually forbidden by law from stating alcoholic strength. In fact, though, he who buys something labelled "beer" gets about 4 per cent alcohol. "Ale" gives him a bit more alcohol than that; "malt liquor" still more, some 6 per cent alcohol.

These limitations are biologically determined, as brewers yeasts cannot survive higher alcohol concentrations. Wine yeasts are sturdier, but they succumb when fermentation reaches about 13 per cent alcohol, which is the upper limit for natural wines. Fortified wines like port and sherry that contain about 20 per cent alcohol are made by adding brandy to wines. Distilled liquors, of course, transcend the biological limits of direct fermentation.

In this country "100 proof" means 50 per cent alcohol. (The British proof system is quite different.) Bottled-in-bond bourbon is legally 100 proof, and some vodkas come in this potent strength. Whiskies, except for the bonded bourbon, are mostly about 86 proof. Gins range from 80 to 94 proof, whereas brandy, most venerable of the distilled liquors, is usually 80 proof. So are most rums. But rum also exemplifies the most potent liquor on the American market—the 151 proof rum largely used in hot buttered rums for the aprés-ski crowd.

Frederic W. Nordsiek has been associated with a number of scientific research and teaching institutions during his career in public health and nutrition, among them Columbia University, St. Luke's Hospital Center, the Sloan-Kettering Institute, and the American Cancer Society. He received his B.S. in biology from M.I.T., his M.S. in biology from New York University, and his Ph.D. in nutrition from Columbia. He has written widely in the latter field.

An average adult can, if he swallows slowly and steadily over a 24-hour stretch of time, take care of roughly seven pints of beer, four pints of wine, or a pint of spirits . . . if he stays awake, slowly sipping, all day and all night.

Despite this heterogeneity in potencies and serving units, American custom dictates remarkable uniformity in the amount of alcohol usually swallowed in one dose. Close to a half ounce of alcohol comes from either of the widely used 12 ounces of beer, 4 ounces of wine, 2½ ounces of sherry or port, or one ounce of distilled liquor. The half ounces of alcohol derived from these several sources act, however, quite differently.

Different Drinks Have Different Effects

The rate at which alcohol enters the human blood stream is very important, for the slower the absorption the more attenuated the impact. A drinker might be physically capable of polishing off a can of beer almost as quickly as a shot of whiskey, but he is likely to take much longer for the beer. Further, the non-alcoholic materials present in beers and wines slow the rate at which their alcohol is absorbed. The concentrated alcohol in distilled liquors has such moderating companions only if fruit juices or other diluents are added in the compounding of cocktails or highballs.

Blood alcohol level, which is what makes you "feel" a drink, depends on the rate at which alcohol is absorbed and the rate at which it is destroyed or excreted. It is excreted hardly at all, as little alcohol passes out with the urine or feces or via the lungs. Although the fetid exhalations of the drunkard are notorious, and although the "breathometer" is useful for finding drunken drivers, only a very small, though proportional, part of the alcohol in the body is exhaled. The drinker's aroma is produced mainly by nonalcoholic components of his libation. Hence the popularity of vodka which, being the purest of pure alcohol plus water, does not cause a "breath."

The human body, then, purges itself of alcohol by destroying it: by burning it up through "oxidation," mainly in the liver. The rate at which alcohol can be disposed of by the human liver, hence safely imbibed, has been clearly established. An adult of average size and body composition can, if he swallows slowly and steadily over a 24-hour stretch of time, take care of roughly 7 pints of beer, 4 pints of wine, or a pint of spirits. Note that he would have to stay awake, slowly sipping, all day and all night. If he downed this much alcohol during just the usual sixteen waking hours, it would pile up in his body, and he would indeed become "intoxicated," that is to say "poisoned," although probably not fatally. It is noteworthy, nevertheless, that fatal poisoning from nothing more than too much alcohol downed too quickly has been authoritatively recorded. In human beings, blood alcohol levels of 0.4 to 0.6 per cent have been fatal. Such blood levels could be attained by the instantaneous downing of the same pint of whiskey we have just seen to be quite nontoxic when sipped steadily during a lapse of 24 hours.

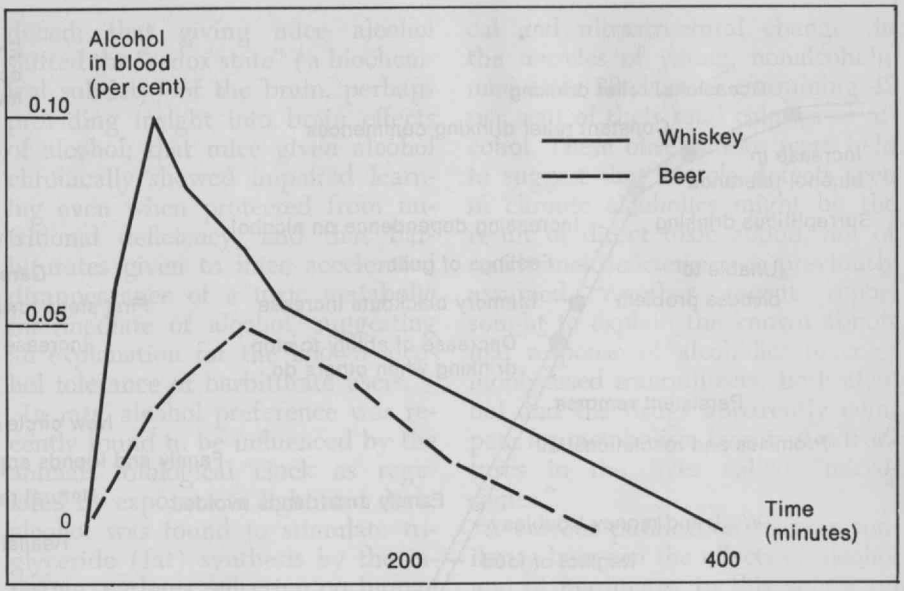
"A large body of data has made it clear that different alcoholic beverages, containing equal quantities of absolute alcohol, do not produce identical blood alcohol levels when ingested. Distilled spirits give the highest levels, fortified wines somewhat lower ones, light wines still lower and beers the lowest." So wrote Leonard Goldberg of the Karolinska Institute in Sweden. He has demonstrated these facts by having normal healthy people, all used to moderate alcohol intake, drink one beverage or the other during a half hour period. The amounts swallowed were adjusted slightly for drinkers smaller or larger than average in body size. But in one experiment all subjects took within a half hour close to either 5 one-ounce shots of whiskey, or 5 twelve-ounce servings of beer. Blood samples were analyzed every 30 minutes or so, until alcohol had entirely disappeared from the drinkers' blood some 7 hours later.

The whiskey, Dr. Goldberg observed, sent blood alcohol soaring to a peak within one hour; whereas the beer had its maximum effect only after about two hours. And even then the highest blood alcohol produced by the beer was barely half as great as that produced by the whiskey. Finally, alcohol disappeared from the blood of the beer drinkers substantially sooner. The figure at the right summarizes these observations. Noteworthy is that, according to drunken driving laws, the whiskey drinkers became drunk whereas the beer drinkers did not.

Dr. Goldberg selected subjects *accustomed to moderate alcohol intake.* This feature was essential to his precise experimental design, because there is a well defined tolerance to alcohol, depending upon customary intake. Persons who regularly consume substantial amounts need larger doses of alcohol to produce a given pharmacologic effect. If, however, the drinker abstains for some months tolerance vanishes and the original responsiveness to alcohol spontaneously returns. Although alcohol tolerance is undisputed, there is no agreement as to its mechanism. A recent report showed that in alcoholics, ingested alcohol disappeared from the blood stream

twice as fast as in normal subjects. Why was not explained.

Another variable in the pharmacologic action of alcohol is the amount of fatty tissue in the body—whether or not the drinker is obese. As we shall see presently in a discussion of drunken driving, large people in general are less affected by a given dose of alcohol than small people. This relationship holds, however, only so far as body size is not due to obesity. Fat tissue has a low water content, and cannot dissolve its share of alcohol. Therefore obese drinkers are more susceptible to alcohol than lean persons having the same body weight.



The nature of the drink that contains it affects how people react to alcohol. Dr. Leonard Goldberg gave 51 gm. in either beer or whiskey to subjects accustomed to alcohol, to find that it affected their blood levels quite differently: the whiskey drink sent their blood levels much higher for a longer time than the beer. (Data: Goldberg, L., Quarterly Journal of Studies on Alcohol, Suppl. 1, 1961, p. 48.)

"Never Before Sundown"

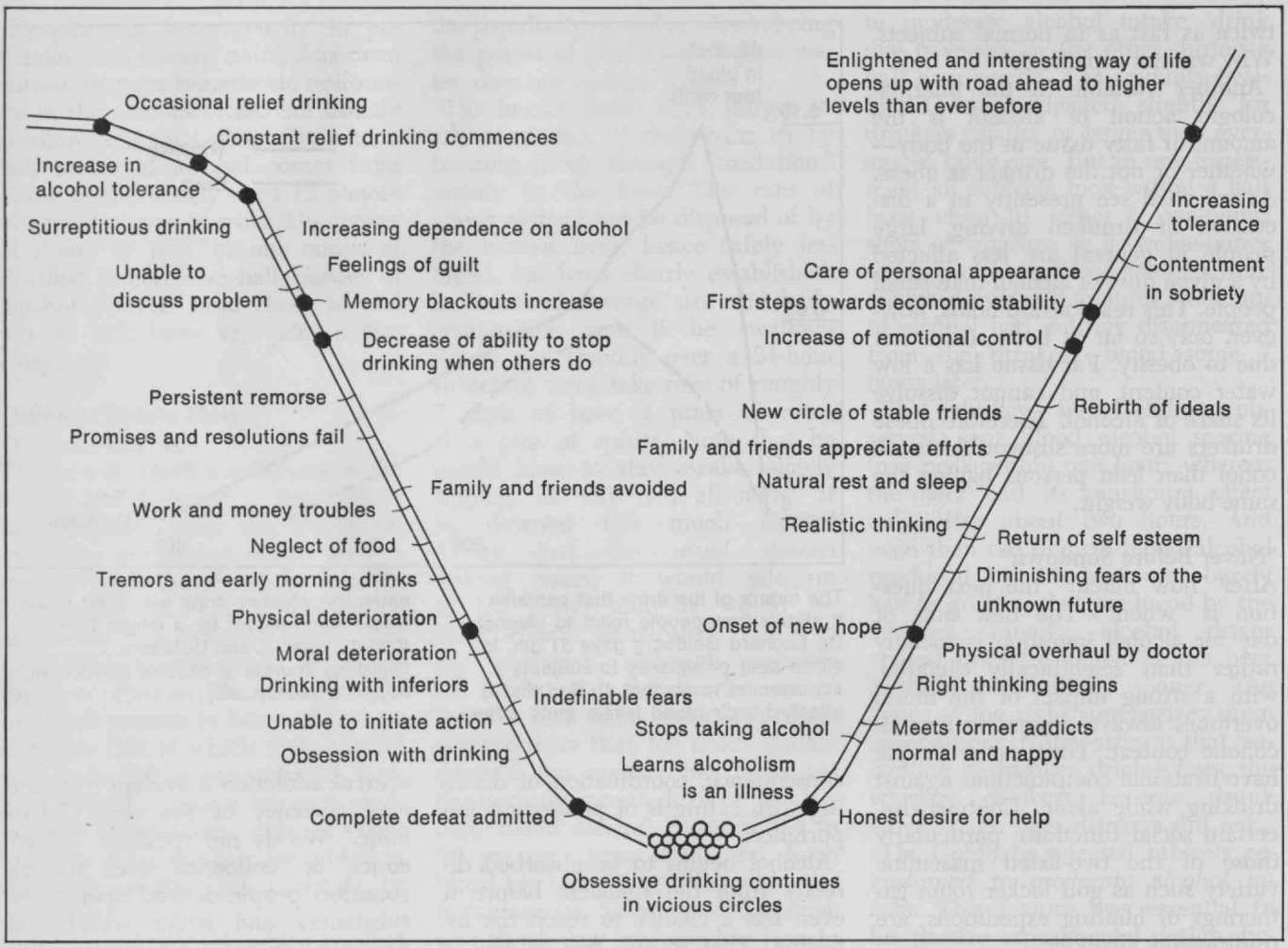
After "how much?" the next question is "when?" The best time of day for alcohol ingestion is socially rather than scientifically dictated, with a strong impact of the moral overtones always present in any alcoholic context. Thus, many people have irrational compunctions against drinking while alone. Contrariwise, certain social functions, particularly those of the two-fisted masculine variety such as golf locker room gatherings or hunting expeditions, are traditionally alcoholic.

The businessman spurning a lunchtime martini may state categorically "I *never* drink at mid-day." In the heyday of the Empire, the British official in the tropics was said to observe two inviolable rules, always dress for dinner and never drink before sundown. The American "happy hour" is traditionally a late afternoon pre-dinner rite. All these usages converge on making alcohol intake coincide with eating of the heavy meal of the day. This makes sense for although the time of day when alcohol is swallowed is of no consequence, coordination of drinking with eating is of paramount importance.

Alcohol begins to be absorbed directly from the stomach, before it even has a chance to reach the intestine. That is one reason why it acts so promptly. Other foods, to the contrary, are not absorbed until after they leave the stomach, and their presence in the stomach slows the absorption of alcohol. The Frenchman having wine with his *boeuf bourgignon* or the German washing down his wurst with beer may with impunity imbibe more alcohol than Americans who cushion their preprandial martinis with only a few salted peanuts.

Kitty Cat Kicks the Habit

That alcohol can produce a dire state of addiction is evident from the easy currency of the word "alcoholic." We do not speak of "tobacco-ics" or "coffee-ics" even though countless people depend upon these substances and suffer withdrawal symptoms if deprived. Alcohol addiction, as we all know, can produce grave physical, social, and economic misery. Alcohol overdosage, as indulged in by addicts, usually ends in irreversible damage to the liver. Extreme and prolonged alcohol addiction can end in what is called "chronic brain syndrome associated with alcoholism," whose victims suffer severe personality changes, delirium, confusion, amnesia, talkativeness about things that never happened, inflammation of the nerves, and pain in the arms and legs. Objective brain damage may be diag-



The telltale signs show all too clearly how the alcoholic falls inexorably into degradation, and—with hope—they recount his rise again into the sunshine.

The attitude is, as Dr. Nordsiek writes, behavioral and moralistic: it demonstrates the kinds of rehabilitation that are traditional.

(Chart: Adapted from M. M. Gellet, "Group Therapy in Alcoholism." British Journal of Addiction, vol. 54.)

nosed by the electroencephalogram.

Sufferers from this end result of alcohol excess crowd our mental hospitals. How to rehabilitate the human alcoholic is the subject of much controversy, and the beneficiary of vast sums in research grants, as from the U.S. National Institute of Mental Health. Biochemical bases of alcoholism are sought, but the main thrust has been behavioral or perhaps evangelical, as shown in the above "Chart of Alcohol Addiction and Recovery."

One experimental model of alcohol addiction is the domestic cat. Ordinarily this creature spurns milk containing alcohol if offered side by side with plain milk. But the picture changes when the animal is made "neurotic" by the following experiment. The cat is taught a simple task by the usual procedure of rewarding correct performance with food. After the routine is well learned, punishment by a blast of cold air is, with increasing fre-

quency, substituted for the reward. After several traumatic attempts to do what he had been taught, the animal withdraws and shuns food even if freely offered. If now offered a milk "highball" he selects it over plain milk, and drinks avidly. While "under the influence" he may become sufficiently rash to risk the punishment-reward sequence again. If his frustration is maintained, he becomes apathetic, does not groom himself, ignores live mice he once hunted savagely, and becomes subservient to other cats he formerly dominated. The entire sequence may be reversed (slowly and with difficulty) by petting the cat, protecting him from conflict, getting him finally to attempt the learned task again and now rewarding him well for each success. Once thus "rehabilitated," the cat regains his initial aversion for alcohol. The investigators hold that these observations suggest both a cause of and a cure for human alcoholism.

Young chimpanzees have recently been proposed as animal models of human alcoholism. These creatures accept alcohol orally and, like man, develop metabolic tolerance, exhibit dependence symptoms on withdrawal, and in time suffer liver damage.

Small laboratory rodents, always inexpensive and convenient, are the objects of much alcohol research. Within the past year published studies using mice have reported that habituation and dependence can be produced merely by maintaining heavy alcohol vapor in the air of mouse cages; that mice so made dependent on alcohol were not helped by an opiate antagonist, thus controverting a hypothesis that physical dependence on alcohol results from an opiate internally produced; that giving mice alcohol shifted the "redox state" (a biochemical subtlety) of the brain, perhaps providing insight into brain effects of alcohol; that mice given alcohol chronically showed impaired learning even when protected from nutritional deficiency; and that barbiturates given to mice accelerated disappearance of a toxic metabolic intermediate of alcohol, suggesting an explanation for the known alcohol tolerance of barbiturate users.

In rats, alcohol preference was recently found to be influenced by the animals' biological clock as regulated by exposure to light and dark; alcohol was found to stimulate triglyceride (fat) synthesis by the intestine, perhaps reflecting on human alcohol-induced fatty livers; rats given alcohol freely "drank to excess," developed unequivocal physical dependence, and suffered seizures upon withdrawal; rats given anti-alcoholism drugs did develop an aversion to alcohol, but also spurned ordinarily attractive saccharin solutions, suggesting that the alcohol aversion was not specific but merely an association with a noxious agent; alcohol given to rats potentiated a normally occurring soporific biochemical called gamma hydroxybutyrate, suggesting a reason for the sleep-inducing effect of alcohol.

Alcohol studies directly on man are difficult but nevertheless are pursued unflaggingly. It was recently reported that Japanese, Taiwanese, and Koreans responded with marked facial flushing and symptoms of intoxication to doses of alcohol having no effect upon "Caucasoid" subjects. The differences in response were concluded to be inborn, and were attributed to differing reactivity of the autonomic nervous system. Another new study detected biochemical and ultrastructural changes in the muscles of young, nonalcoholic men after 28 days of consuming 42 per cent of their total calories as alcohol. These observations were held to suggest that muscle defects seen in chronic alcoholics might be the result of direct toxic action, not of nutritional deficiencies as previously assumed. Another recent report sought to explain the known abnormal response of alcoholics to commonly used tranquilizers. Both alcohol and the drugs apparently compete for metabolism by minute structures in the liver called "microsomes."

A current publication stresses similarity between the effects of alcohol and of marijuana. In this vein a recently published philosophical discussion holds that marijuana and alcohol both fulfill an innate human need to "get high," indulged in by all cultures throughout history, except the aboriginal Eskimos who because of their location could not grow anything either to ferment or to smoke. But the ever forthright Spiro Agnew adds another conclusion: ". . . alcohol has been known for thousands of years and it has won the approval of people and governments."

The High Cost of Hangovers

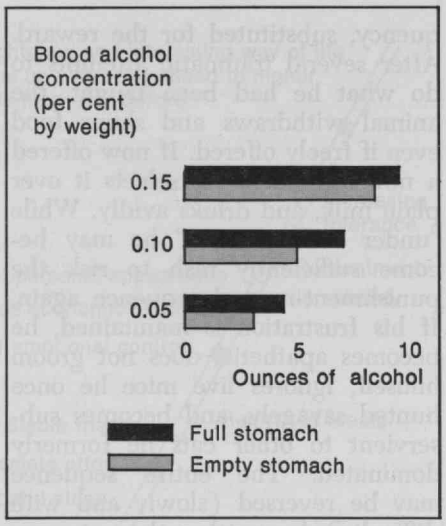
Alcohol is an expensive medicine. Most of its high cost is a result of heavy taxation, which yields important governmental revenue, and also ostensibly modulates the consumption of this potentially dangerous drug. That untaxed, unadvertised liquor is very cheap is known to anyone who has purchased perfectly potable rum in the tropics for a half dollar a large bottle. Federal taxation of distilled spirits has not always been heavy as today. In 1862

The soothing effect of alcohol: to move the drinker "from the chill periphery of things to the radiant core . . ."

the rate was only 20 cents per proof gallon, and this rate stayed below a dollar until 1894. Frequent large increases in the rate started in the 1940s and continued until 1950 when the $10.50 per proof gallon, still in effect today, was legislated. State and local levies are additional. As a result taxes now take the lion's share of the retail price of a typical fifth-gallon bottle of domestic whiskey, as follows:

Cost of production	$0.50
Packaging, advertising, profit, etc.	1.50
Taxes	3.00
Retail price	$5.00

Actually the high cost of booze has more effect on the *type* of alcoholic beverage chosen than on the total intake. The vagaries of alcoholic beverage taxation are such that, with resourcefulness, it is possible to get drunk quite inexpensively. Take the Briton who buys an Imperial pint of beer in a pub for about 30 cents. This draught contains more than 19 U.S. ounces, and is full to the brim because British beer is served without a "head." Thus for 30 cents the Britisher obtains a bargain amount of alcohol in beer equal to that in 3 bar measures of whiskey (legally set in Britain at 1/6 of an Imperial gill), each costing as much as the pint of beer for a cost of almost a dollar for the same dose. The American tax system makes beer by no means the cheapest tipple here. If you read labels of empty bottles which litter the congregating places of derelicts in city parks and Skid Rows, you will see that they contained domestic port, sherry, or related fortified wines. These potations cost little more than ordinary wines but supply half again as much alcohol. For alcoholic action they are much cheaper than American spirits or beers. That is why the alcoholic at the economic end-of-the-line is the "wino." But when drinking of alcohol progresses to alcoholism, total cost vastly exceeds purchase price of the drug. An arresting statistic of this economic waste comes from a recent report of the Comptroller General on the 3 million people who work for the U.S. Federal Government. From 4 per cent to 8 per cent of these employees were estimated to be alcoholics; and the consequent losses from absenteeism, suboptimal work output, and accidents was set at $275 to $550 million a year. Legislation has been proposed to implement a rehabilitation program that could largely be paid for from existing civil service accident and disability insurance.



It takes more alcohol to reach the same level of alcohol in the blood—and therefore to feel its effects equally—on a full stomach than on an empty one, as probably any experienced drinker can testify. In this chart, a full stomach means the drinker has eaten one hour before the hour in which he drinks the amounts of alcohol listed.

Alcohol as a Food

Alcohol is perhaps the only major drug which has important food value as well. It is a rich source of calories: some seven calories per gram, much more than carbohydrate or protein and only slightly less than fat. Such high calorie value has substantial significance not only in calorie restriction, but also in the reverse.

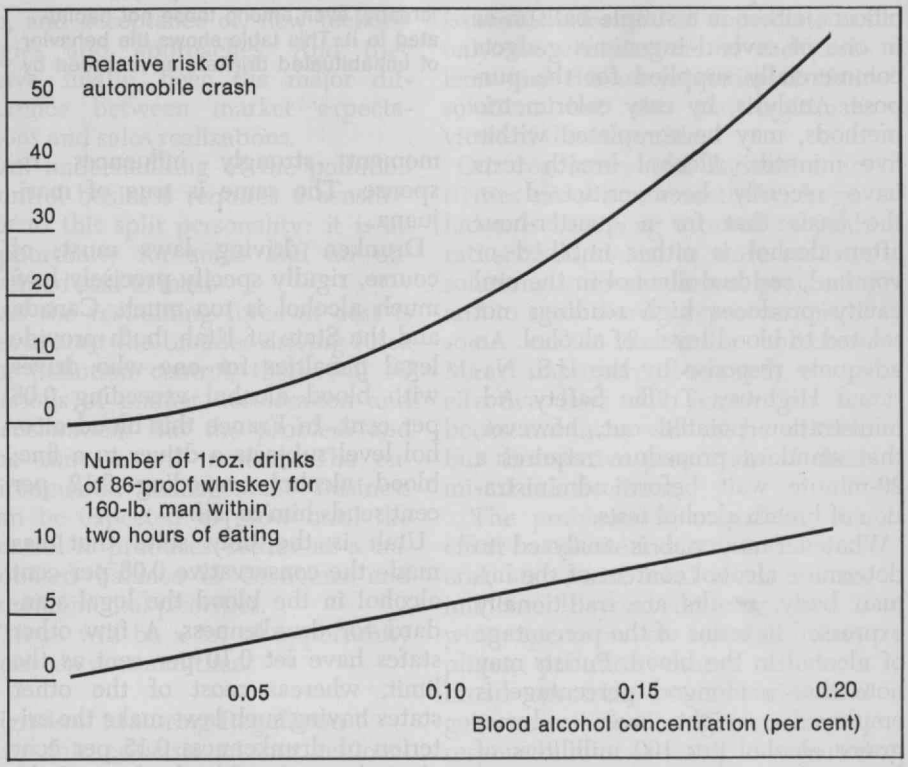
Obesity has been called America's number one public health problem, and countless people fight the battle of the bulge by counting calories. If they fail to figure in their liquor, which provides some 125 calories per jigger—as much as a serving of ice cream—they may face defeat. Also the inhibition-reducing effect of alcohol is all too apt to weaken willpower to refuse second helpings at the table.

The high calorie value of alcohol is uniquely useful in intravenous infusions for patients unable to swallow or unable to absorb nourishment from their intestinal tracts. Intravenous infusions of dilute alcohol are the only way that the calorie needs of some such patients can be met. Concentrated sugar solutions so used damage the blood vessels, dilute sugar solutions waterlog the patient's body, and preparations of fat or protein have various adverse effects if given intravenously.

Alcohol infusions are used clinically by dripping into the veins, at a slow and steady rate over a full 24 hours, about a half pint of alcohol, diluted to 5 or 6 per cent in a salt water solution. This amount of alcohol provides some 1300 calories, enough for a bed-ridden patient who

cannot eat.

Infusions of alcohol yield interesting confirmation of the amount of alcohol the human body can handle, for patients receiving infusions as just described show no signs of inebriation. The half pint of alcohol in the daily infusion is roughly equivalent to a pint of whiskey, which, as stated earlier, is not toxic if swallowed in small amounts over a full 24 hour span. Thus through either the vein or the stomach, the amount that can be tolerated is the same.



The number of drinks a person has bears a linear relationship to the alcohol content of his blood—but a far from linear relationship to his chances of having an automobile accident, as this chart (adapted from one published by the National Highway Traffic Safety Administration) shows. Most states place the legal limit on blood alcohol at 0.10 to 0.15 per cent—if in fact legal limits are specified.

Alcohol as a Menace

Serious side effects of alcohol in overdose include the muscular incoordination, the slowing of reaction time, and the narrowing and dimming of field of vision which add up to befuddlement. In our present day world-on-wheels, automobile accident deaths caused by drunken drivers are far more tragic than the end results of chronic alcoholism. In 1969 some 35,000 Americans died in automobile accidents caused by drunkards. For comparison, 15,000 people were murdered, and some 10,000 American soldiers died in Vietnam. How may such risk be avoided? The figure at the left, which encompasses the major variables of body size and fullness of the stomach, attempts to provide a basis of estimate. But the question remains; how much blood alcohol makes a driver unsafe?

As remarked earlier, alcohol in the blood stream is what makes one "feel" a drink. Minor effects of alcohol, such as a slight skin flush, and small increases in gastric acidity and urine output, are produced by the drug coursing through the body in the blood stream. But the major impact of alcohol, producing both the desirable and the dangerous drug effects, is on the central nervous system, principally the brain. When a cadaver results from an alcoholic episode, a piece of the brain is routinely assayed for alcohol content. With living subjects, blood, saliva, urine, or exhaled air provide good measures of alcohol content of the body. Body fluids and tissues are readily analyzed by separating the alcohol by distillation or desiccation and measuring it by one of numerous accurate chemical or physicochemical assays.

Because the plumbing of the human body is so complicated, alcohol levels of brain, blood, urine, and exhaled air do not necessarily correspond at any one moment. Arterial blood alcohol concentration matches that of the brain, but blood is not readily collected from arteries of the living person. Capillary blood, obtained from a finger tip prick, corresponds closely to arterial blood in alcohol content. Venous blood, as traditionally drawn from a cubital vein in the forearm, lags far behind arterial blood when levels are rising because alcohol is being absorbed. Alcohol moves but slowly from the blood stream into urine already in

the bladder; whereas fresh urine just leaving the kidneys closely parallels alcohol level of the blood.

Happily, expired air provides an accurate as well as a most convenient measure of alcohol in the arterial blood and thereby in the brain. Alcohol in the blood is dissolved in water. Aqueous solutions of alcohol in contact with air obey Henry's Law; irrespective of the strength of the solution the air phase equilibrates at close to 1/2100 of the alcohol concentration in the liquid phase at body temperature. Breath samples are readily collected by nonmedical personnel such as police officers, either in a simple balloon or in one of several ingenious gadgets commercially supplied for the purpose. Analysis, by easy colorimetric methods, may be completed within five minutes. Alcohol breath tests have recently been criticized on the basis that for a quarter-hour after alcohol is either imbibed or vomited, residual alcohol in the oral cavity produces high readings not related to blood levels of alcohol. An adequate response by the U.S. National Highway Traffic Safety Administration pointed out, however, that standard procedure requires a 20-minute wait before administration of breath alcohol tests.

Whatever material is analyzed to determine alcohol content of the human body, results are traditionally expressed in terms of the percentage of alcohol in the blood. Purists may note that a mongrel percentage is employed, weight over volume; grams alcohol per 100 milliliters of blood. The effects of blood alcohol on the human being have been studied intensively and extensively. Observations have been made of behavior of drinkers, their subjectively reported symptoms, and results of objective, usually quantitative, tests as of vision, hearing, reaction time, equilibrium, perception, muscular coordination, manual dexterity, and ability in mental tasks. The remarkable consensus shown at the top of the next column has emerged.

Assuming all subjects were unhabituated to alcohol, two explanations for the overlap of blood alcohol values for each gradation from sobriety to extreme inebriety may be offered. First, even unhabituated individuals vary somewhat in responsiveness to alcohol as to all drugs. Second, in the early stages of alcoholic influence, social setting at the moment strongly influences response. The same is true of marijuana.

Percentage of alcohol in blood	*Behavior*
0.01-0.05	*Sober.* Slight changes revealed by sophisticated tests.
0.03-0.12	*Euphoric.* Sociable, talkative, self-confident.
0.09-0.25	*Excited.* Impaired critical judgment, memory, reaction time, muscular coordination.
0.18-0.30	*Confused.* Disoriented, dizzy; impaired vision, speech, gait.
0.27-0.40	*Stuporous.* Apathetic, inert; impaired consciousness; vomiting.
0.30-0.50	*Comatose.* Unconscious; subnormal temperature; urinary and fecal incontinence; possible death.

Alcohol affects different people differently, even among those not habituated to it. This table shows the behavior of unhabituated drinkers as recorded by objective tests and subjective evaluations. The overlap of blood alcohol values for various conditions from sobriety to extreme inebriety is of special interest.

Drunken driving laws must, of course, rigidly specify precisely how much alcohol is too much. Canada and the State of Utah, both provide legal penalties for one who drives with blood alcohol exceeding 0.08 per cent. In France this blood alcohol level subjects a driver to a fine; blood alcohol exceeding 0.12 per cent sends him to jail.

Utah is the only state that has made the conservative 0.08 per cent alcohol in the blood the legal standard for drunkenness. A few other states have set 0.10 per cent as the limit, whereas most of the other states having such laws make the criterion of drunkenness 0.15 per cent alcohol in the blood. Some half-dozen states, largely in the South, lack such laws.

The West German Penal Code specifies punishment for driving with blood alcohol exceeding 0.13 per cent. The Transport Minister there is pushing for a reduction to 0.08 per cent, holding that the lower level is not exceeded when a person of average build drinks four or five beers, or else one schnapps with two or three beers as chasers. He is quoted as saying that ". . . .drunken driving must lose its popular image as a gentleman's crime. . . ."

It is of interest to compare the drinking pattern considered by the New York State Senate with that pondered by the French General Assembly when they passed drunken driving laws.

The New York legislators accepted testimony that a 170-pound man, after dining, could toss off 10 one-ounce shots of 80 proof liquor before danger loomed. This statement did not go unchallenged; one Senator who voted unsuccessfully against the bill held that only two "jiggers" (equal to three "shots") of Scotch whiskey (usually 86.8 proof) would threaten disaster for a driver. The French law was based on presumption that a Frenchman can drive safely after dining to the accompaniment of not more than one apéritif (sherry, vermouth, etc.), plus a half bottle of wine, plus one brandy. Note that no self-respecting Frenchman would down, as many of us do, dose after dose of the same liquor.

Either the New York State or the French alcohol allowances are surely ample to provide anyone with the soothing effect of alcohol, to move the drinker ". . . . from the chill periphery of things to the radiant core . . . ." as the great philosopher William James characterized the ardent touch of alcohol. Why swallow more alcohol than that? Modern knowledge of this widely used though frequently abused medicine has proved that drinking alcohol rarely if ever helps us do anything better, but only makes us unaware of doing things less well.

Suggested Readings

Grossman, H. J. *Grossman's Guide to Wines, Spirits and Beers,* Scribner. Rev. Ed. 1955.

Roueché, B. *Alcohol,* Grove. 1962.

Stewart, C. P. and Stolman, A., Eds. *Toxicology. Mechanisms and Analytical Methods.* Vol. II, Chap. 4, p. 85ff. "Ethyl Alcohol," R. N. Harger. Academic Press. 1961.

Terry W. Rothermel
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The Profit Side of Pollution Control

The business of environmental management is not necessarily a high-growth, high-profit opportunity. The path to success is strewn with obstructions, and innovative technology is the least of the requirements for its navigation.

Pollution control has become an accepted requisite, not simply a whim, of an affluent society. Cleaner air and water are not so much luxuries as conditions necessary to ensure health, safety, and quality of life. Cleaning up and recycling are not only answers to disposal problems; they are also a part of conserving diminishing natural resources.

The driving force behind business opportunities in environmental management is the fact that it has become an accepted social goal—it is a broad-based scientific, public, and political concern.

But those of us enmeshed in the positive side of pollution control, i.e., its opportunities for new technology and enterprise, find it too easy to forget that the main thrust of the environmental movement upon industry has been a negative one. In fact, most of the problems and frustrations of the environmental management business can be traced to its basic negative impact.

Environmental management is a source of cost, not of profit, to most industries. The cost aspects of pollution control clearly contribute to the difficulties of government regulation. They largely predetermine the reluctant attitude of potential customers. They influence the interest in, and acceptance of, new technologies and approaches. And they have, finally, been *the* major difference between market expectations and sales realizations.

An understanding of the pollution control business requires a sensitivity to this split personality: it is an opportunity for some and an unwanted cost to most.

As the restraining force of cost is set against the broader driving force for pollution control, there will be periods of market acceleration and deceleration. But the problem and the concern will remain. The environmental management business can be expected to grow until the control it produces settles at a negotiated balance of economic and environmental priorities.

There will be a lot of opportunity between now and then.

Signals of Maturing Regulation

Any fair criticism of our national progress in pollution abatement must be tempered with an appreciation of the size of the task it represents. As a totally new area of government responsibility, the regulation of pollution has faced more than the usual number of start-up problems. But the record is improving. A few short years ago the situation was often summarized as one of losing ground less rapidly: we were beginning to control pollution, but we were producing problems faster than we could deal with them. Today we are probably, on balance, close to keeping up—though we are not yet catching up.

We have markedly departed from the simplistic positions of environmental prophets and industrial apologists. Progress is now being made because a growing number of representatives on both sides of pollution issues have learned to appreciate not only the complexities of the problems and the uncertainties of their solutions but also the legitimate views of the other side.

Our regulatory and legislative activities show a new maturity. Legislation is becoming attuned to goals rather than ideals, to more realistic solutions, to more relevant programs, and to second-order repercussions of some earlier first-order solutions. Many improper, ill-advised, or ineffective laws still remain on the books and many will yet be written; but the relative proportion of these mistakes is declining.

The problems of organizing this effort in private industry and at federal, state, and local levels remain immense. Beyond drawing upon a wide spectrum of scientific disciplines, pollution control affects a broad spectrum of industries and governmental bodies. Environmental responsibilities are still distributed among many federal agencies, even though the Environmental Protection Agency (E.P.A.) was designed to alleviate that lack of organization. More important, perhaps, the creation of E.P.A. separated the function of environmental advocacy from the functions which the other agencies provide to their industries and associated vested interests.

Environmental regulation has also been impaired by the lack of personnel experienced in the field. The passage of time has helped this situation, too—more people are now conversant with the problems, and some of the oversimplified views typically held by new recruits in a new field are disappearing.

That past efforts in regulating pollution were adolescent is made clear when we count the number of deadlines that have passed by and the

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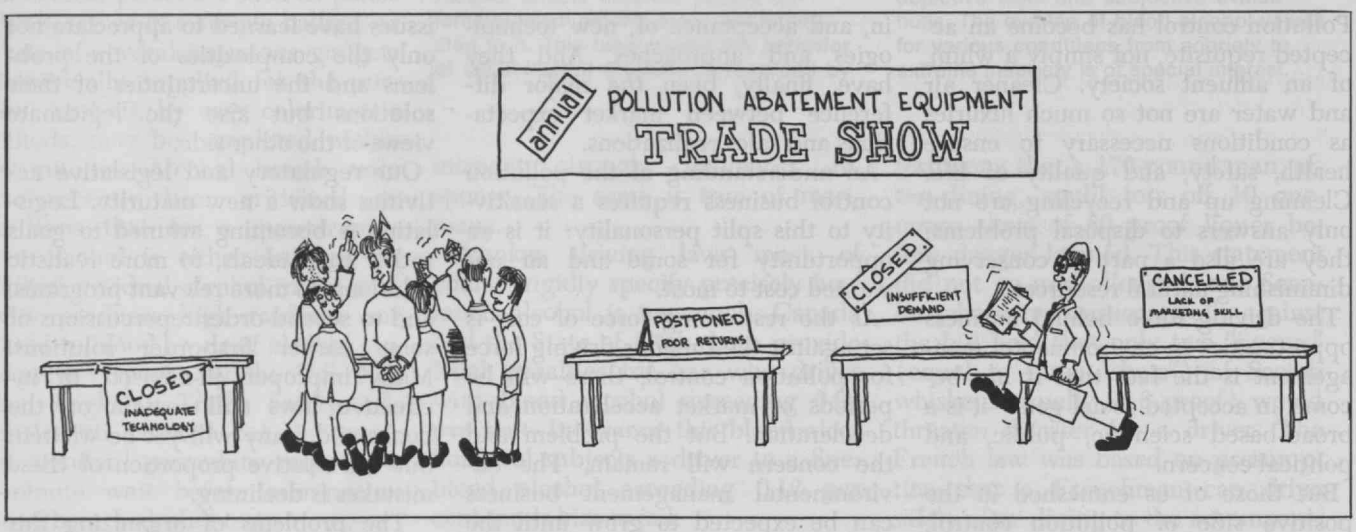


Few readers could have doubted that the author would categorize pollution control as a high-risk industry. He shows the several pitfalls in this drawing: failure to understand the competition, failure to understand the market, failure to correctly estimate the technological problems, failure to correctly estimate the market resistance . . . But given all these hazards, Dr. Rothermel nevertheless concludes that "there still seems to be time to build the proper blend of technology and marketing upon which to base a substantial position in future pollution control markets."

number of standards that remain to be set. The earlier programs of the federal government were directed towards measurement and control of pollution on an ambient basis: the concern was for the general quality of a stream or the quality of the air. Such a program frequently leads to controlling polluters within a critical area while competitors outside that area remain uncontrolled; the result is an adverse competitive market position for the controlled competitor.

There are also problems of predicting with some certainty when and if controls will be required of certain pollutors. A control policy designed around acceptable levels of pollution in a stream or air-shed adds, in practice, substantial uncertainties to an already uncertain and costly process.

As the standard-setting machinery has matured, it has become more oriented to effluent and emission standards. Such plans may well be economically inefficient, in the sense of requiring treatment where hydrologic or climatic conditions may not warrant it. But absolute standards are easier to administer and more equitable to competitors, and they present much less uncertainty for all parties. The trend to source standards may be moving even further: a recent court decision seems to interpret the 1970 Clean Air Act as protecting against degradation of air of whatever quality. This interpretation corresponds to the belief of some that an incremental change in environmental quality is as important as the level of quality itself.

We are beginning to see a redefinition of what pollution standards are, what they are meant to do, and how inviolate they should be. Earlier standards were often inadequate because of unrealistic definition and expectations. The standards being set now reflect more of what we have learned about the strategies of enforcement, an understanding that a standard is needed even though all relevant questions have not been answered. Today's standards are seen more flexibly, as goals that probably can—but may not necessarily—be satisfied in a given period of time.

Standards are also being designed to give certain control approaches a chance. One example will be those that evolve from the 1972 amendments to the Federal Water Pollution Control Act. Although "zero-discharge" was dropped as a formal legislative requirement, it remains a target for regulating implementation by 1983-1985.

Today's standards, then, should be viewed as goals having no necessary claim to immortality. If a standard becomes impossible to enforce either technologically or economically, it

will simply become unenforceable. If it can be met, it will just as certainly be tightened up at a later date. Even though E.P.A. has the charter and the legislative power to enforce such a standard, the checks and balances of the legislative, economic, and political process will make it impossible to enforce compliance that clearly conflicts with national economic capabilities.

An important indicator of the growing maturity of the national pollution control program is illustrated in the chart on page 52, which traces the distribution of Congressionally-authorized monies for construction of municipal sewage treatment facilities. Just a few years ago, a similar analysis of obligations in contrast to Congressional intentions (appropriations) would have revealed a considerable lag in this very important area of funding; that lag is less today.

In addition, there has been a more basic discrepancy between appropriations (annual budgets voted by Congress) and authorizations (amounts provided by legislation). Since fiscal 1969, actual appropriations have totalled 80 per cent of initial authorizations, and the five-year performance has been brought up to 66 per cent. Obligations over the last five years have amounted to 90 per cent of cumulative appropriations—up from about 60 per cent in a similar five-year analysis of fiscal 1966-1970. In fiscal 1971, the obligations even exceeded the annual appropriation and began to catch up with previously unobligated (unspent) monies. The outlays of grant monies occur a few years beyond the point of obligation, because of the delay inherent in municipal sewage facility planning, financing, and construction. The trend of outlays has increased sharply in fiscal 1971 over previous levels. This could well mark the beginning of the sewage facility growth markets that have been so long anticipated and unrealized.

This discrepancy between legislative promises and actual outlays created a waiting game in the one environmental management market—municipal sewage facilities—where federal funding can have its greatest impact. As a result, that impact has even been somewhat perverse. Communities that planned to build new facilities have put off their plans in anticipation of federal help; and because that federal help did not materialize as expected, the sewage treatment market plateaued in the late 1960s—just at a time when it was expected to expand. Much of the federal assistance promised now, in fact, will serve only to compensate communities for the interim inflation.

Another unfortunate reality is (according to a review by the U.S. Government Accounting Office) that much of the earlier monies could have been more efficiently distributed. Grants in the 1970s have been directed more towards modern technologies, advanced treatment methods, regionalized treatment systems, joint (municipal-industrial) treatment projects, and to the more serious needs of urban, rather than suburban, treatment authorities.

What has been most significant about the national environmental effort in 1971-1972 has been its shift into an enforcement mode. Our experience in the other stages should have prepared us for a number of mistakes in this one; there will, for examples, be misinterpretations of legislation and unrealistic enforcement of the unenforceable. But there will be more action, and that will mean, at last, more certain markets for pollution control products and services.

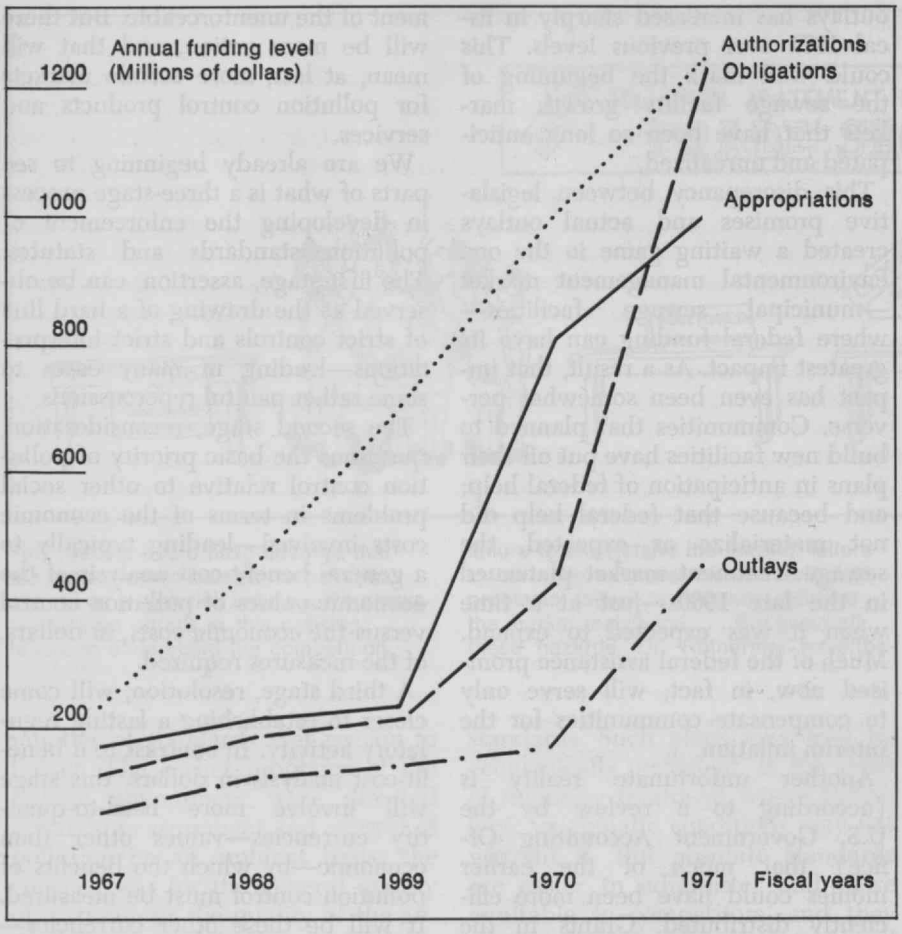
We are already beginning to see parts of what is a three-stage process in developing the enforcement of pollution standards and statutes. The first stage, assertion, can be observed as the drawing of a hard line of strict controls and strict interpretations—leading in many cases to some rather painful repercussions.

The second stage, reconsideration, questions the basic priority of pollution control relative to other social problems in terms of the economic costs involved—leading typically to a general benefit-cost analysis of the economic values of pollution control versus the economic costs, in dollars, of the measures required.

A third stage, resolution, will come closer to establishing a lasting regulatory activity. In contrast to a benefit-cost analysis in dollars, this stage will involve more hard-to-quantify currencies—values other than economic—by which the benefits of pollution control must be measured. It will be these other currencies—as well as dollars—with which we finally determine what our society is willing to pay.

A Reluctant Customer

One of the rewards of selling usually lies in the satisfaction of a customer who in purchasing a product enhances his own product, productivity or profits. In the environmental management business, however, the motives of the prospective customers are not necessarily so positive. A pollution control customer is a reluctant one. He may have learned to accept pollution control as a legitimate cost of business, but he sees it still as



The rapid recent growth of federal grants to municipalities for wastewater treatment plants would seem enough for a bullish market in wastewater management and purification. But this chart also indicates one reason for the modest results thus far achieved by most entrants into the field: while only 60 per cent of Congressional authorizations have been obligated during the five-year period from fiscal 1967 through 1971, actual outlays were but 28 per cent of authorizations. (Data: Environmental Protection Agency)

only that: a generally unprofitable prerequisite for doing business.

A supplier of pollution control products can at best only relieve some of his customer's problems. Unlike most salesmen, he cannot rely on the motives of product or profit improvement to enhance the sale. Unlike an insurance man, he cannot rely on an established customer practice of planning ahead. Unlike a doctor, he cannot count on an ascribed image of the dedicated customer savior. Perhaps like a lawyer, a pollution control specialist must be viewed as a customer servant hired by necessity rather than choice.

The role of the pollution control supplier is to get or to keep a customer out of trouble. This analogy with the lawyer helps in understanding the characteristics of the pollution control customer, the negative pressures which determine the final need for the control product, and the deferrals and frustrations of the business.

The pressures on a customer which lead to the final choice of pollution control equipment are manifold. In these times, pollution control accounts for an average of 5 per cent of total new plant investment; it can account for as much as 10 to 15 per cent of new construction costs. These are incremental investments made without prospects of normal return in profit. Every customer would like to defer such expenditures indefinitely.

Other pressures also work to delay a purchase decision. The customer is faced with uncertain control requirements. He must choose: he can meet existing minimum requirements and risk an expensive redesign later; or he can make a larger investment now to build a system to handle predicted future requirements, risking a misreading of those demands. In many cases, pollution control standards are a moving target that presents a very strong possibility that a system may become obsolete before it is fully depreciated.

Dimensions of the Market

When we speak of environmental management as an industry, we include businesses in air pollution control (not including mobile sources), water and wastewater treatment (not including oil pollution), and solid waste management.

The interests of Wall Street and the

Fortune 500 in these markets are as new as the national priority on the environment, but the enterprises now serving these markets are long-established. Trash collection and disposal have existed since man became a consumer of materials. Centralized sewage treatment has been an institution in this country for some time. The collection of dusts and other particulate matter has long been a housekeeping practice of American industry. These markets represented a multi-billion-dollar business even before the environmental era began.

The total markets in environmental management, for pollution-related products and services, are estimated in 1972 to be almost $14 billion. This includes capital and operating costs for facilities currently in use and the specialty products and related services required for their operation.

The more profitable opportunities lie primarily in that small part of this total market which is most associated with new requirements and technologies; these smaller markets for specialized products and services now represent less than 15 per cent of total expenditures, or $1.65 billion in 1972.

Such specialized products and services are the main business interests of the so-called pollution control companies. Other industries—e.g., general construction, cement, pipe, and earth-moving equipment—will benefit as well from the growth of environmental activity; but they will be secondary beneficiaries when compared to higher growth markets for new control technologies.

The overall air pollution control market is an order of magnitude smaller than the market in water and solid waste treatment because less civil works construction is associated with air treatment facilities. But in terms of the specialty products and services required, the air pollution control market, $550 million in 1972, is nearly as large as that for water and wastewater treatment and larger than that for solid waste management. The air pollution products and services market is growing very rapidly—over 15 per cent a year in recent years and projected for the next five years as well. This is due to two factors: The practice of air pollution control is not as old as the water and solids sectors. And except for municipal incineration, air pollution control is mainly an industrial problem; since industry can generally move faster to solve its problems than can municipal authorities, air pollution control is responding more rapidly to clean-up pressures.

The market for gaseous emission control equipment represents the greatest potential source of error in the air pollution control projections. The demand for economically attractive sulfur dioxide control processes is very great; if such processes were to become available tomorrow, or if regulatory bodies become more stringent in their enforcement of existing requirements, that market would accelerate at an unprecedented pace.

The water and wastewater treatment business continues to represent the largest segment of environmental management, in terms both of total expenditures and of markets for specialty products and services. Somewhat more than half of the total expenditures in this segment are for wastewater treatment, and more than half is spent by municipalities. The wastewater treatment proportion of the total will continue to grow because of a great backlog of needs. The municipal market will continue to dominate the overall nature of the water and wastewater treatment business. The relatively modest overall growth rate of 9 per cent per year will reflect not only the new emphasis upon pollution control but also the levels of expenditures established before the 1960s.

Higher growth rates are doubtful in water and wastewater treatment because of the substantial base of current expenditures and the delays between the point of decision and final completion which are inherent in municipal construction. The market for specialty chemicals has grown rapidly (15 to 20 per cent annually) in recent years but the level of market penetration now precludes a continuation of that growth.

The solid waste management business has long been a multi-billion-dollar business; society has long been forced to dispose of solid wastes in order to provide a tolerable local environment. Its overall growth rate, 5 per cent per year, is the lowest of the three market segments. Physical collection and transportation of solid wastes alone account for more than 75 per cent of the total costs of disposal. A major portion of the business is, of course, municipal. The specialty equipment and related services market of $300 million in 1972 relates primarily to disposal devices and systems.

The transportation, collection, and municipal aspects of the solid waste problem provide large targets for innovative systems development and almost insurmountable constraints upon real opportunity. The markets for equipment and services are likely, short of major innovation, to grow but little faster than the overall market in the near term.

	1972 Estimate (Millions of dollars)	1977 Forecast	Growth (Per cent/year)
Total Expenditures[1]			
Air	$ 900	$ 1,800	15
Water[2]	8,000	12,300	9
Solids	5,000	6,400	5
Total	**$13,900**	**$20,500**	**8**
Specialty Products and Related Services			
Air			
Products[3]	$ 300	$ 650	17
Related Services[4]	250	600	19
Total	**$ 550**	**$ 1,250**	**18**
Water			
Equipment[5]	$ 550	$ 900	11
Chemicals[6]	250	400	10
Total	**$ 800**	**$ 1,300**	**10**
Solids			
Total	**$ 300**	**$ 400**	**6**
Total	**$ 1,650**	**$ 2,950**	**12**

[1] Includes both capital and operating costs.
[2] Includes both water and wastewater treatment markets.
[3] Equipment, instrumentation, and replacement materials.
[4] Services provided by product manufacturers.
[5] Equipment and instrumentation.
[6] Does not include commodity chemicals.
[7] Equipment only.

Even with impending legislative deadlines, environmental management will remain only a modest growth industry in the next five years. Total expenditures will increase, on the average, 8 per cent a year. The market for specialty products and related services will grow faster—on the average 12 per cent a year; but it will remain less than 15 per cent of the total expenditures for environmental management, and it is a competitive and entrenched market. With ineffective marketing, even the most innovative technology for environmental management is in peril. (The air pollution control market is absolutely smaller than the water and solid waste markets because no large-scale civil works are involved; but its growth in the next five years will exceed that in water and solid waste management because air pollution control is relatively newer and because it is an industrial—not a governmental—responsibility.)

Dimensions of Competition

The health of any growing business—including one in environmental management—depends largely upon keeping a reasonable balance between supply and demand. If industry capacity greatly exceeds demand, prices and profit margins will be low; and this is the situation which appears to prevail in environmental management today. Although this may be to the advantage of current pollution control customers, we sense a dilemma: if profit margins remain low over the long haul, the low returns may discourage the investment needed to solve future problems. If, on the other hand, capacity becomes short, products and services will be at such a premium that the national clean-up program will suffer.

Most of the conditions in the environmental marketplace have thus far worked to cause oversupply. On the demand side, regulatory progress has fallen short of legislative ambition. The customer is motivated to defer and reduce his expenditures. Conditions on the supply side have worked to make capacity greater than required. Corporate needs to diversify and to tap growth markets, market needs for better technologies, and an overly optimistic view of market growth have created a capacity which is far beyond current demand—thus far, anyway.

For the private investor and Wall Street, for the corporate development department and the board of directors, the pollution control business has been deemed a glamour industry. For the private investor and Wall Street, the promise has been largely self-fulfilling, resulting in price/earnings multiples of 30 to 40 and above for established companies. ("New issue" stocks of unproven firms have not fared as well.)

The product market has been less rewarding than the stock market, and the competition to serve the growing pollution control markets has been strong. As long as demand continues to fall short of expectations and as long as press coverage continues to excite the interest and encourage the entry of new companies into the field, competition is likely to remain intense.

But even if the intensity of competition remains stable, the lineup

of competitors and the nature of their competition will not.

So it is that in the last decade, though an impressive number of new suppliers have entered the business, industry leadership has remained more or less intact. Most of the successful entries into the business have been achieved by the acquisition route. Earlier prophesies that the environmental problem was simply waiting for solution by space-age firms with new technologies have not proven out; it is now clear that the environmental challenge offered more of a solution to the problems of the aerospace industry than vice versa.

Achieving market leadership on the basis of technological prowess has not generally worked because lack of marketing skill and know-how continue to represent major barriers to success. While the traditional pollution control companies cannot match the technological resources of the larger aspirants to their business, they enjoy this all-powerful advantage on the marketing side.

Until the acquisitions of recent years, the leaders in the environmental management business were companies of $100 million or less in total sales. Their market position had been established over many decades in the businesses of dust collection, sewage treatment, and trash disposal. The technologies required for adequately performing those functions had been developed for some time, and so competition became established on a price basis; there was little profit or incentive upon which to build a research and development activity.

Now that environmental requirements have been added to the housekeeping incentives which formerly stimulated these markets, there is a clear need for new technologies to meet emerging standards. It is equally clear that many of the familiar companies lack the wherewithal to fund, staff, and prosecute new research and development activities.

But the resources of these firms must not be underrated, particularly by potential competitors. Their main assets are the ones which still control the marketplace: customer contacts, intimate familiarity with the manufacturing processes of an industry, and experience in applying existing technology to specific customer problems.

If the leadership in the pollution control business has not changed in the last decade, it is likely to change more in the next. This is because only large corporations with extensive research and development capabilities—uncommon now in the industry—will be able to meet the inevitable need for new technologies and systems. The entry of such corporations will not necessarily depose the current leaders, because of the latter's strong marketing capabilities. A more likely scenario suggests various forms of alliance between the present leaders and the new companies—acquisition, licensing, and joint bidding.

Guides to Commercialization

The environmental management business has special attraction for aerospace firms and other major corporations because many of its basic problems seem to lend themselves to technological solutions. This is not so clearly true of other current domestic problems. But this perceived need for technological hardware is both a source of opportunity and a source of dangerous preoccupation. Although pollution abatement calls for technological solutions, its implementation involves the same nontechnical factors that affect other domestic problem areas. Thus, it is more correct to say that the environmental management business offers only a somewhat greater opportunity for technology than do other domestic problems.

A common generalization heard in the business is that the technology already exists to abate pollution over the near term, that the limiting factors are in legislation, enforcement, and funding. Some spokesmen stretch this generalization to claim that the technology exists today to meet even the more difficult challenges of recycling wastewater or solid waste and controlling the gaseous emissions from either stationary or mobile sources. Far fewer ask whether the technology is economically feasible and whether society is willing to pay in multiples of current expenditures for future pollution control. If the opportunity is not thus economically attractive, it is more useful to conclude that the technology is *not* available.

As has been noted, legislation will influence the kind of technology which will be most attractive. In wastewater treatment, for instance, will future programs be directed at treatment and disposal or at closing the loop by separation and reuse? In solid waste management, land fill would play a very large role under a government philosophy that favors disposal; but under a philosophy that leans to conservation and recovery, land fill would play a much narrower role. Which will it be?

Another question upon which depends the effectiveness of research and development activities: Will the business remain open to participation by a number of suppliers each

Constraints of Marketing on Technology.

Causes of Failure of U.S. New Products:	
Inadequate market analysis	45%
Product problems	29
Lack of effective Marketing	25
Higher costs than anticipated	19
Competitive strength	17
Poor timing	14
All other	36

Why U.K. Research and Development Projects Were Dropped:	
Unattractively small market	36%
Lack of marketing capability	26
Lack of production capability	24
Only one potential buyer	23
High level of competition	21
Five other reasons	6-13 each

Underestimating the market aspects of a new product occurs in environmental developments as it does with new products generally. This table summarizes recent results from separate American and British studies of the failure of new products and research and development projects. In the U.K. study, four of the top five reasons for failure are related to marketing aspects; in the U.S. study, the first, third, fifth, and sixth sources of failure were marketing-based.

contributing his product, or will it develop into a "system" market requiring "turnkey" capabilities? If the market remains attuned to multicomponent systems provided by a broad spectrum of suppliers, the most profitable research and development strategy is to exploit specialized technologies which promise patent protection. If "turnkey" installations are fostered by federal grants (for example, for municipal sewage treatment plants), opportunities will clearly lie with companies with full lines of products and broad capabilities. At the present time, this "systems approach" in air pollution control implies the provision of a broad line of products plus the additional services of design, installation, and operation.

Other factors are not to be overlooked. There exist avenues for abating pollution by means other than direct treatment, and to the degree that pollution abatement pressures result in process and raw material changes, the need and potential for treatment technologies will be reduced. Many of the options for sulfur dioxide control, for example, lie in a change of raw materials—i.e., from high-sulfur to low-sulfur fuels. Similarly, many solutions to nitrogen oxide emissions from stationary sources will come from improved process and combustion engineering practice. Adopting such options would create a market in effecting the transition from old processes to new ones—but much of this transition will take place in-house in the major corporations and manufacturing facilities.

One of the pitfalls in the development of pollution control technology has been a kind of reverse twist upon the common "N.I.H." (not invented here) syndrome. This problem in environmental management might be called a "developed in-house" or "home-grown product" effect. It works this way: many internal engineering staffs have been chartered to solve corporate pollution problems. These technically competent staffs have often developed what appear to be novel technologies for use in their company's facilities. So far, so good. The problems begin with the irrepressible speculation that this technology might be more widely applicable; three risks then arise. One is a lack of appreciation within the company of competitive products already in the marketplace; one of these might even have provided a better solution in the initial application. Another danger is the assumption that a technology can be generally applicable when it has been engineered to a specific process and situation.

But the greatest pitfall for a home-grown technology, even when it is truly novel, is the tendency to believe that it will sell itself. The fact is that no product is going to sell itself in a market such as that for pollution control, where there is already a profit-shattering noise level of claims and counterclaims. Indeed, most customers have been so conditioned by the broken promises of the past that they will probably favor the old and proven to the new and promising.

Another difficulty with the home-grown product is that it has been developed by engineers or scientists who will understandably de-emphasize the aspects of its commercialization which they understand (or care for) least—the marketing functions of pricing, promotion, distribution, and packaging.

One clear lesson of the environmental management business is to give the marketing of environmental technology the respect it demands. Where proprietary advantage exists it resides on the marketing, not the technological, side of the business. The problems of marketing have derailed many attempts by large companies to enter the environmental market on the basis of internal capabilities; and marketing power has been a motivating force behind successful acquisitions.

Blending Technology, Marketing and Timing

The history of new product development teaches that a good product at the wrong time is as bad as no product at all. The marketing approach to new product development further holds that it should all begin with the assessment of need—followed by a review of candidate technologies and subsequent development of the attractive ones. In environmental management, a further lesson is that no technology will sell itself; even the best of technologies must compete amidst a high noise level of alternative products and technologies.

To develop a team that is expert in environmental markets requires many months, and experience suggests that at best the job will not be done easily and probably not on time. But there still seems to be time to build the proper blend of technology and marketing upon which to base a substantial market position in future pollution control markets.

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Trend of Affairs

Trends This Month

MAN IN THE AIR 59

Sailplanes as scientific tools . . . Motors for motorless flight.

LIFE SCIENCES 61

The first long-term study of the effects of oil pollution.

LAW 61

A computer "to improve the quality of justice" . . . Toward a consumer's guide to food . . . and its regulation.

BIOENGINEERING 63

How to help the blind understand their environments . . . Stresses on the hip . . . Laser sterilization . . . An ultrasonic view of the inner brain.

COMPUTERS 65

The Japanese miniaturize everything—except computers . . . The dismal record of computer software . . . and how a hierarchical view may help to improve it.

TRANSPORTATION 66

Some of the old romance is still in flying . . . A new shape for roads, and so for cities . . . and new financing for the airways.

STRUCTURES 68

A tube turns out to be an economical building.

MAN IN THE AIR

Eavesdropping on the Weather

Just as the soaring eagles are the elite of Aves, so the pilots of gliders and sailplanes must be among the elite of men. Fortunate are those hobbyists who can turn the subject of their avocation into a primary research tool for their vocation.

Three such meteorologists are Theodore W. Cannon, J. Doyne Sartor, and Win Toutenhoofd of the National Center for Atmospheric Research in Boulder, Colo., who fly N.C.A.R.'s automated sailplane "Explorer." Their enthusiasm stems not only from the exhilaration of soaring, for the sailplane is a fine tool for meteorological research, in some respects absolutely without parallel, they told the First International Symposium on the Technology and Science of Motorless Flight at M.I.T. last fall.

The sailplane is by its fundamental nature light and its wing loading very low, so it creates little turbulence of its own, and is exquisitely sensitive to whatever winds encompass it. Having no power, it is absolutely clean, leaving behind no nuclei to accumulate raindrops. It is maneuverable and almost instantly responsive, with a turning radius two orders of magnitude smaller than that of any jet aircraft. It can carry man as well as instruments to the heart of almost any weather he wants to study—silently and inconspicuously.

Thousands of glider pilots and multitudes of birds have learned to use "thermals"—columns of warmed air rising into cumulus clouds. But with "Explorer" it has been possible to learn the structure of such updrafts, to learn that there are two types—and to learn that the upward movement of air extends not simply to the cumulus clouds at perhaps 27,000 ft. but to at least another 15,000 ft. into the stratosphere.

The similarly familiar mountain lee wave—wind pitched into an enormous wave form as it spills down a mountain range—is also shown to be higher and more turbulent than previously supposed, extending into the stratosphere to perhaps 70,000 ft. And, said the three N.C.A.R. fliers at M.I.T., their work with "Explorer" has yielded for the first time "an almost complete picture of the onset of precipitation in cumulus clouds."

The originators of motorless flight—which has been a subject of interest at M.I.T. for 63 years since students and faculty entered the field (the first university to do so)—may have seen themselves as aerodynamicists and even courageous explorers. But not at all as meteorologists.—*J.M.*

Power to the Powerless

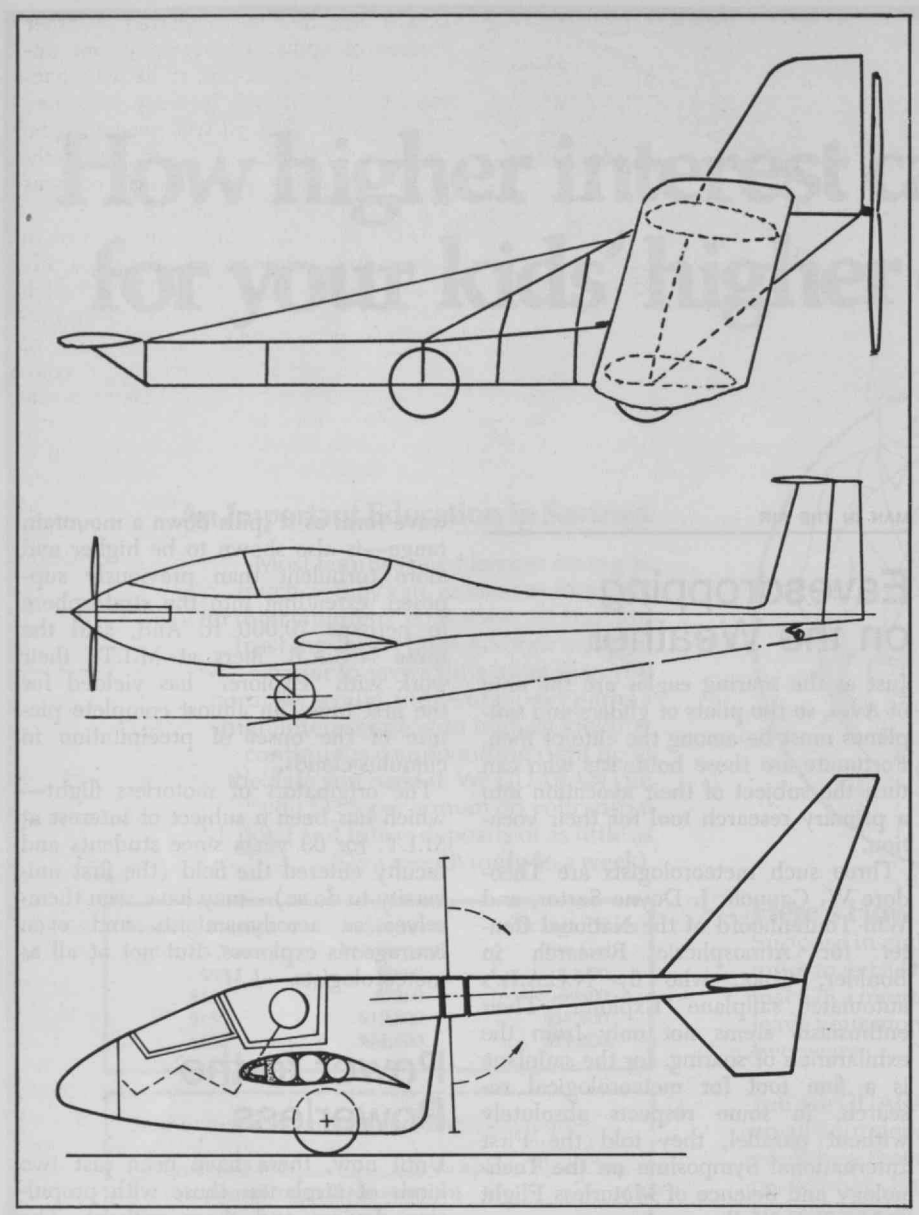
Until now, there have been just two kinds of airplanes: those with propulsion devices and those without. The distinction has been very clear and has been proudly maintained by the soaring clan, among whom the notion of fitting even a small engine has been regarded as roughly equivalent to shooting the albatross.

But now there are two kinds of powered sailplane: man-powered and engine-powered. The former is of course an expression of the ancient and hazardous urge to fly like a bird, using one's own muscles for take-off and for travel to the nearest rising air current or smooth landing spot. The latter is a response to practical expedience in a crowded world where inadvertent landings can be extremely costly.

At the First International Symposium on the Technology and Science of Motorless Flight last fall at M.I.T., both were treated in a single session on "self-launching" craft—though not all devices described can, or ever could, launch themselves.

Man's Dreams of Self-Propelled Flight

Last July, a man-powered aircraft



Three powered-glider concepts: M.I.T.'s almost-completed tandem pedal-driven canard biplane; the D-39, a German advance on today's motor-augmented gliders, with a snowmobile engine and a propeller that will fold down onto the (horizontal) air intakes during glide; and the proposed Archaeoptery, with pedal drive to an energy-storage device (still problematical) and folding propeller mounted on an annulus around the fuselage.

achieved a flight of over 1,000 yards. But so far no one has come near the ultimate goal of take-off followed by a figure-of-eight flight around two points half a mile apart, the criterion set by the British Kremer Competition, which carries a £10,000 prize. The difficulty of this objective is the two course-changes it entails. To turn, an aircraft must bank; and in that process it requires more power to sustain altitude than in level flight. Even level flight under continuous human power is at the limits of what is physiologically and aerodynamically possible.

As described at the symposium, a Kremer Prize entry aspirant now being built at M.I.T.—nearly completed at the time of writing—maximizes power-to-weight ratio by having a two-man crew instead of a single occupant. (This is in line with current trends for man-powered flying machines.) As in other such machines, pedal power is transmitted to a large aft-mounted propeller. The horizontal stabilizer surface is forward. To achieve a large wing area at minimal structural weight, the aircraft is a biplane, with a span of 62 ft. Balsa frames covered with .001-in.-thick nylon film comprise the wings, which are described as "perhaps the lightest rigid air-structure (0.2 lb./sq. ft.) that has ever been made." The whole machine is expected to weigh less than 130 lb. unoccupied. Designed and being constructed by a six-student group led by Robert M. Peterson and Paul L. Hooper, Jr., it will be operated initially by two well-trained cyclists, one of whom also is a pilot.

There are other kinds of man-powered flight in the air and on the drawing-board. Since power requirements of a gliding craft are intermittent rather than continuous, John H. McMasters (Tempe, Arizona) and Curtis J. Cole (University of Michigan, Marquette) suggested at the symposium the development of energy-storage devices between pedals and propeller. They have designed a man-powered sailplane carrying three drum-wound, rubber-cord energy-storage devices which they calculate could launch it to a height of 500 ft., where perhaps it could catch a rising thermal current.

Grant Smith, also of the University of of Michigan, proposed to achieve powered flight without drive machinery. He believes that the essence of bird flight, as regards energy transmission, is the raising and lowering of the center of gravity relative to the wings. He envisages a "pseudo-ornithopter," with rigid wings, in which the pilot would rhythmically perform a kind of crouching pushup by grasping a knee-high supporting member. In theory, such an aircraft should go into a falling and (more rapidly) climbing oscillation, "pumped" by the synchronized movements of the occupant.

Simpler yet is the hang-glider, essentially a 24-ft. delta wing of fabric on a light metal frame (modelled on N.A.S.A.'s experimental parawing). As explained by Michael A. Markowski of Man-Flight Systems Engineering (Marlboro, Mass.), the pilot runs downhill carrying the delta wing. At about 20 mi./h, and depending to a great extent on his skill, confidence, and avian tendencies, it begins to carry him. (Mr. Smith looks to the hang-gliders to provide the opportunity for a verification of his pseudo-ornithopter principle.)

Motorized Sailplanes

Modern sailplanes are no longer aimed at ever-lower weight; some actually carry ballast, for it is found that extra inertial mass can confer a penetration advantage under strong thermal uplift conditions. There is thus the possibility of carrying an engine without much decrease in soaring performance except for the drag penalty of an idle propeller. Supporters of motorized gliders claim that engine propulsion is useful for self-launching, for seeking out strong thermals, and for hazardous landings.

If one must motorize a sailplane, then there are at least two ways of avoiding propeller-drag. A jet engine has been used, but is said to do violence to the

pilot's auditory system. Another technique featured in the D-39, which was described by Wilhelm Dirke of the Darmstadt Technische Hochschule, is folding the propeller back against the fuselage. The power, in this design, is provided by a 36-h.p. snowmobile engine.

The British Gliding Association's Ian Strachan (in an account read at the symposium on his behalf by Nick Goodhart of the U.K. Ministry of Defense) called for great care in writing the competition rules for this new class of aircraft, for the rules will guide its evolution. He believes, fundamentally, that use of the engine should be penalized so that it will be reduced to a minimum and that the essence of gliding, even with an on-board propulsion unit, must continue to be skill in finding and riding the ascending thermals.—*Fred Wheeler*

LIFE SCIENCES

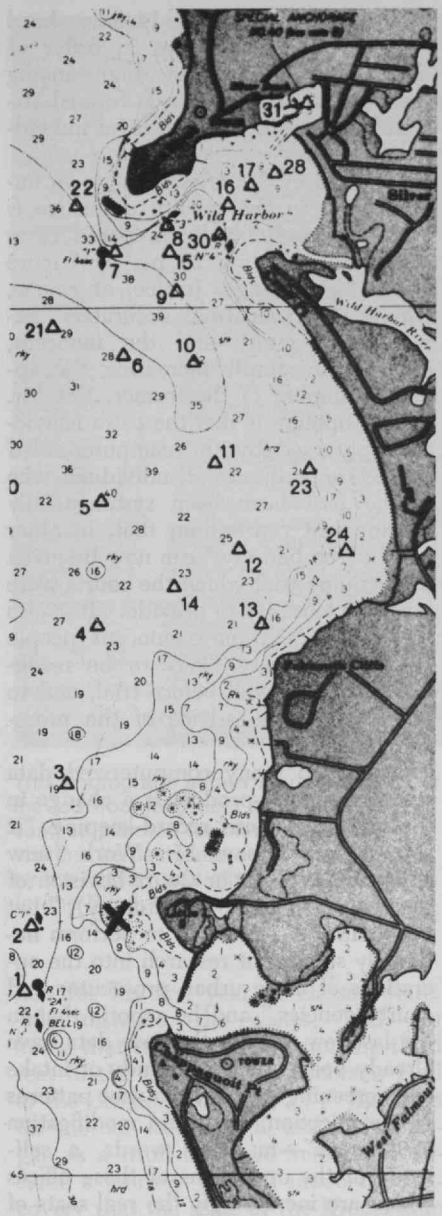
Slow Rejuvenation

What happens to salt marshes and tidelands and estuaries after an oil spill, and to the oil that fouls them? On September 16, 1969, the oil barge *Florida* spilled six hundred metric tons of number two fuel oil in Buzzards Bay, Mass., in the back yard of the Woods Hole Oceanographic Institution (W.H.O.I.) whose scientists have since then studied its degradation, and the renewing of the life it killed.

For about two years, W.H.O.I. scientists took monthly samples of the sediment at some 30 stations up the coast from the spill, in the Wild Harbor River, the Silver Beach Harbor, and offshore. They counted living and dead animals and by gas chromatography they analyzed the components of the oil. (The findings of Max Blumer and Jeremy Sass, who did the chemical analyses, and of Howard Sanders, J. Frederick Grassle, and George R. Hampson, who did the biological ones, are reported in unpublished manuscripts W.H.O.I. 72-19 and 72-20 respectively.) This study, the authors write, is the first long-term study of a small area previously clean.

In the first few days after the spill, the oil killed crabs, lobsters, fish, shellfish, worms, even creatures of only a few cells—in some places up to 95 per cent of all living things in the water and on the sea floor died in a few days. In some places only a few of the simplest species were surviving even many months later.

In the eight months following, the oil spread across over 5,000 acres offshore and 500 acres of marshes and tidal rivers with the same results. A year and a half later, the oil was beginning to be degraded, and a few simple organisms were recolonizing the affected areas from adjacent waters.



The Florida spilled her oil at the spot marked X. The oil drifted up along the coast far into Wild Harbor and there it still remains, much of it. Woods Hole scientists are pessimistic about the rate of its degradation and of the return of a wide variety of life to the spoiled area.

Either bacterial degradation or evaporation and dissolution would be identified by changes in the composition of the oil—evaporation or dissolution by a smaller range in boiling points, bacterial degradation by a lessening in quantity of certain easy-to-eat fractions like the straight chains. Bacterial degradation all over the soiled area proceeds very slowly, the authors write, as do dissolution and evaporation. Each process is much slower than laboratory tests would indicate, and slower than has been reported by other studies of spills. The team is not optimistic that seeding oil spills with bacteria to eat oil will be very effective. They believe that oil will persist in the marsh and harbor and offshore sediments for many years: much oil was still obvious even in June, 1972.

And even after living things return to the sediments where the oil spilled, life is not necessarily normal. Those which have moved from the nearby clean bottom to the fouled one take up some of the oil that is left, and retain it, becoming at least too toxic for human ingestion. Drs. Blumer and Sass also suggest that the hydrocarbons remaining in the sediments from an oil spill might somehow concentrate other non-polar pollutants such as pesticides and thus help to poison the life that depends on the bottom.—*J.K.*

LAW

Twenty-five Per Cent More Justice

"It is the expectation of the United States Attorney that this new computer system will aid him in improving the quality of justice in the District of Columbia," concluded two Washington, D.C., assistant U.S. attorneys in an article published two years ago in the *American Criminal Law Quarterly* (Vol. 9, No. 1, pp. 164-169). This summer the Law Enforcement Assistance Administration announced that the system is operable, and that the Administration s head, Mr. Jerris Leonard, was therefore encouraging 1,300 district attorneys across the country to adopt it. Development of the Washington "prototype" version cost $292,000, provided by the L.E.A.A.

To understand how the Prosecutor's Management Information System (PROMIS) helps the prosecutor to improve the quality of justice it is necessary to realize that the criminal courts in many U.S. cities are now far too busy for each accused person to be "tried", in the classical sense of the term. The majority of defendants are successfully persuaded to save everyone's time by pleading guilty (not necessarily to the crime of which they were originally accused—this is a matter for the now well-established pretrial process known as plea-bargaining). The person who is seriously intent upon avoiding conviction—for whatever reason—may of course, in principle, insist on a not-guilty plea and a trial; but a very common form of defense is to take advantage of the numerous weaknesses of the grossly overloaded court system.

The District of Columbia courts, each working day, face a schedule of over 100 misdemeanor cases. For the prosecution, there are 20 assistant U.S. attorneys, who handle the cases at very short notice "on a mass-produced, assembly-line basis," according to Frederick G. Watts and Charles R. Work in the article cited above. "Given this high volume, advance assignment of the trials to individual prosecutors is not feasible, except on a very limited basis," they write.

The result, as Mr. Work explained it to the *Review*, is that it is just as easy for the prosecutor to lose what in hindsight is seen to have been a strong case, as to lose a weak one. He and his colleagues at the D.C. Office of the U.S. Attorney have long known that they could obtain more convictions if only they could give more attention to each case. Since there is not the manpower available to prepare all cases in advance of the day of trial, the Washington prosecutors concluded that the next best thing was to adequately prepare a specially selected minority of them.

Which minority? A 15-20 per cent minority which is intended to include particularly those people whom Mr. Work and his colleagues refer to in their writings as recidivists, and in conversation as "the bad guys." According to the folk-wisdom of the court room, there are, among the thousands awaiting trial, a small number of professional criminals, whose detailed knowledge of the courts' weaknesses enables them reliably to escape unpunished—unless, as generally does not happen, some prosecutor devotes the same degree of attention to bringing them to justice as they do to evading it. The PROMIS system is, in effect, an automated detective, seeking out the few serious criminals from among the unconscionably large population of arrested persons.

There are four selection criteria (listed in an article by William A. Hamilton, the project's computer programmer, in *The Prosecutor*, Vol. 7, No. 6): the seriousness of the alleged crime, measured on a scale invented in the early '60s by the criminologists Thorsten Sellin and Marvin E. Wolfgang; the seriousness of the defendant's "criminal" record, measured on a scale which was devised by another criminologist, D. M. Gottfredson, as a possible means of predicting criminal behavior in individuals (Mr. Work admits that Washington "criminal" records, which are primarily of arrests, are unhelpful as regards convictions—i.e., verified crimes—and he tells us that the computer also includes the current charge in the accused's "record"); the number of times the case has been delayed; and a prosecutor's initial assessment of the likelihood of conviction. On this four-fold basis the computer, 14 days ahead of trial, ranks the cases in order of "seriousness," and the high-ranking cases are passed to a newly formed six-man Special Litigation Unit for individual attention.

The main evidence offered for an improvement in the quality of justice is that these individually prepared cases result in conviction 25 per cent more often than average. Justice, of course, entails discriminating accurately between the guilty and the innocent, rather than simply increasing the apparent number of the former. But Mr. Work's opinion is that the extra convictions obtained by the computer-aided procedure really are of individuals who in the past have been systematically eluding just retribution; that, in other words, "the bad guy" can now be given the genuine trial which the courts were formerly too busy to provide. (It is also his opinion that any innocent people arrested are very likely to be recognized as such well before trial, and to be freed on the advice of the prosecutor's office.)

As with so many computerized data systems, one by-product is a change in the quality of court record-keeping. "It is our belief," says Mr. Work (now chief of the Superior Court Division of the D.C. Office of U.S. Attorney), "that PROMIS will enable us to perform nationally significant research into the operations of large urban prosecutor and court agencies," and he reports that in the last few months the case data have already been used in "a study of intake and screening practices to spot patterns in the rejection, filing and modification of charges"—in other words, a self-study of the operations of those offices which are increasingly the real seats of judgement.—*Fred Wheeler*

Food Regulations: The Opportunity . . .

"Squeezing a food package tells you as much as kicking a tire," Esther Peterson said—but it may be the best method the housewife has at the moment.

How to do better occupied the attention of five speakers at a panel on food regulation, the topic for the 1972 Underwood-Prescott symposium at M.I.T. last fall. The session was a tribute to Ross A. Chapman, Special Advisor to the Canadian Department of National Health and Welfare, who received M.I.T.'s Underwood-Prescott Memorial Award for contributions to food science and technology.

All panel participants contributed suggestions for regulatory actions, such as open dating that is comprehensible to the consumer, and labels on foods that tell more about their ingredients and their nutritive properties. Both Canada and the United States are beginning to effect new labeling requirements.

Sherwin Gardner, Deputy Commissioner of the U.S. Food and Drug Administration, spoke of requirements the F.D.A. wants to have adopted: to label the kinds and percentages of fats in foods; to adopt content and nutritional standards for certain classes of foods such as prepackaged meals; to specify the kinds of nutritive claims permitted; to label the percentage of the characterizing food; and to have manufacturers list on their labels the nutrients included. That last is proposed as voluntary, but once a manufacturer volunteered he would have to tell the truth.

The Canadian efforts are not very different. Dr. Chapman explained that Canada presently permits foods to be identified as good or excellent sources of particular nutrients, depending on the percentage of the recommended daily intake they contain. The labels on foods to which nutrients are added by the processor must say exactly how much of what was added. But Canada's present system is not comprehensive or general enough, Dr. Chapman explained—his department is looking for a better one which will provide more specific information.

But Esther Peterson (who is Consumer Adviser to Giant Food, Inc.) clearly had the most rigorous set of recommendations: percentage ingredient labeling, grade standards to reflect the nutritive quality of the foods offered for sale, open dating of goods, unit pricing, and labels informative of real nutritional value.

Further suggestions from this former Assistant for Consumer Affairs to President Lyndon B. Johnson: a national consumer library, to collect information about human nutritional requirements, the wholesomeness of foods and processes, and the like; a set of national standards for foods that would clarify the language of the market place; and advertising that stresses the true nutritional qualities of food, not the "emotionality of sex, personal achievement, and success." (Such advertising would probably require a smaller advertising budget, she added, and food might even come to cost a little less.)—*J.K.*

. . . and Its Price

The typical consumer advocate's view of food manufacturers' responsibilities is at best oversimplified, and at worst an invitation to government by the shifting sentiments of a "public that is sometimes apathetic, sometimes in a panic, but never soundly informed." This was the addendum which Esther Peterson's remarks (*see above*) drew

from Robert L. Hall, Vice President for Research and Development of McCormick and Co., Inc.

The demand for assured nutritive value in food products—in which Dr. Hall joined the other speakers at the 1972 Underwood-Prescott Symposium—conflicts with some of the realities of the food business, said Dr. Hall:

☐ The term "food industry," he said, is a "simplistic misnomer." It covers farmers big and small, processors, transporters, marketers, and retailers—"far too diverse, large and competitive a complex to be regarded as a single entity."

☐ Everybody in the chain from grower to retailer is in business for profit. The problem of malnutrition as a consequence of poverty is simply outside the reach of this conglomerate loosely termed the "food industry," because its victims are "outside the reach of the money economy."

☐ Cost is a function of complexity. As the reach of regulation increases, the effect of its increasingly complex requirements can only be to increase growers' and processors' costs. But complexity makes it hard, too, for consumers to understand the sources of what they consume.

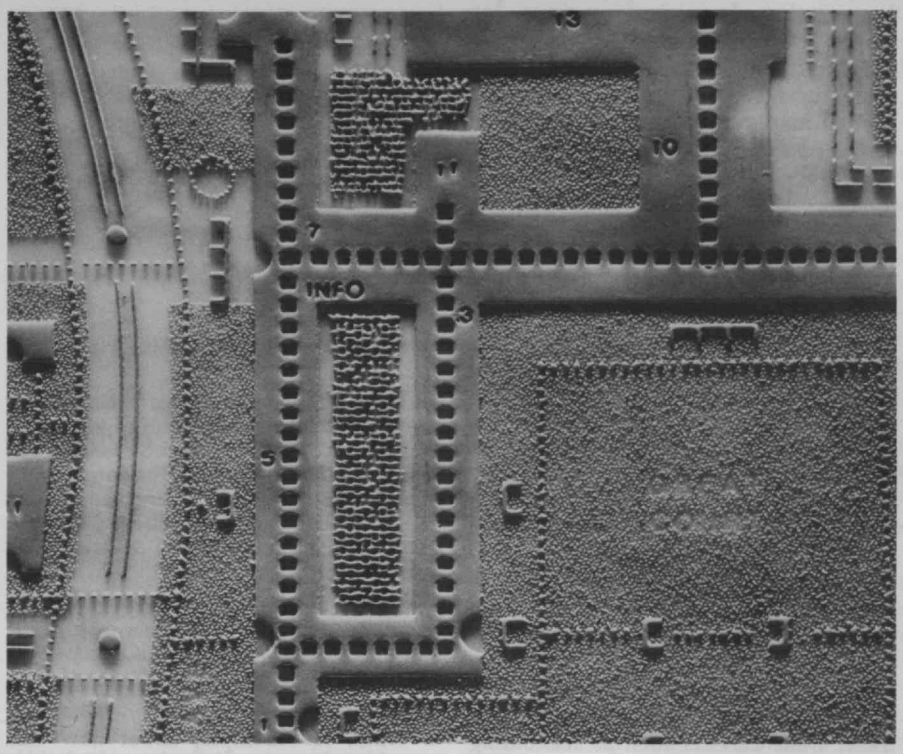
And so today we confront a dilemma: either "rule by a governmental elite with a diminution of individual choice," or "abandon the field of decision to an uninformed public." Beyond all the regulations, upon which he and other speakers could easily agree, said Dr. Hall, we must educate people in "the basic fact that there is some risk in everything, that every benefit has a cost, and that wiser behavior means not escape but an informed choice."—*J.M.*

BIOENGINEERING

Toward Maps to Be Seen by the Blind

A map is to be looked at, to reproduce spatial relationships between physical things for those who want to move among them. For those of us who can see this is both obvious and simple: we match symbols with their corresponding reality. But what about a map to be perceived by those who cannot see the things through which they wish to move?

Blind people have in fact created their own maps—both in braille and in their minds. But it is a painstakingly slow process, limited by the help they can find from sighted people for their first explorations. Harold Krents, a blind student who has chronicled his adventures at Harvard in *To Race the Wind*, describes how he and his mother travelled the Harvard Yard in preparation for his first year of classes there. "For instance," he writes, "did you know that it's 122 steps from the third seat in the front row of Emerson Hall to the drinking fountain . . ." But then his mother went home, and "what began as a stroll to Social Sciences 1 became a journey when I made the discovery that the scale of the Krents map was based on the length of my mother's footsteps rather than my own."



This photograph shows a small section of the four-foot-long map of the M.I.T. campus planned for blind students and visitors. Its designers—who were helped by the Howe Press of the Perkins School for the Blind, the American Foundation for the Blind, and countless other groups at M.I.T. and elsewhere—think it may prove the feasibility of "portable urban maps" to help the blind "travel freely about an unknown city."

Intrigued by the problems of describing two- and three-dimensional space nonvisually, two M.I.T. architecture students, working with John A. Steffian, Associate Professor of Architecture, several members of the M.I.T. Planning Office, and many other groups concerned for and knowledgeable about blind people's aids, spent more than a year trying to understand how blind people conceptualize their surroundings and their routes between familiar places. In their joint master's thesis, Ann M. Kidwell and Peter S. Greer developed a nonvisual graphic system for communicating environmental cues and signals that blind people need in unfamiliar places. Now, as a practical demonstration, they have used this system to construct a map of the M.I.T. campus which they believe is "one of the most detailed and complex tactual displays ever attempted."

The campus map consists of two sheets of polyvinyl chloride bonded together. On one is a physical representation of the campus; on the other, registered to the mirror image of the first, are campus information in braille and symbols for such features as doors, stairs, ramps, and crossings. In each case, the information is put on the polyvinyl sheets as colored resinous powder melted into a photoengraved mold; the two sheets bonded together produce a durable map which can be rolled or even folded by the user.

How do blind people view their environment—and how can they best be helped? With a few exceptions, Miss Kidwell and Mr. Greer found that blind students most strongly characterized the campus in terms of circulation, organizing their view of M.I.T. "around the routes with which they were most familiar."

"Because their perceptual impressions are highly fragmented," say the two young students, "a blind person has to devote considerably more effort and energy to close the information loop between map and environment." Hence the cartographers' question to blind M.I.T. and Harvard students: What information did blind people need? A general outline of buildings, streets, sidewalks, corridors, and entrances, of course. Also steps and the direction of steps, various paving textures, entrance types (revolving doors, electric-eye doors, or whatever), mail boxes, shore

lines, eating places, parking areas, bus stops, traffic signals, street crossings, overhead building connections. Linear scale turned out not to be critical; a tactual map can, in fact, be somewhat distorted to provide greater detail in critical areas if necessary.

When planning travel from one place to another, the blind students were far less concerned to avoid hazards than to find the shortest route; "pleasant travel was synonymous with maintaining as much composure as possible."

Among problem obstacles, blind travellers listed "passing-chance events" —piles of snow, chained bicycles, trucks blocking sidewalks—as by far the most difficult to cope with. Fixed obstacles—trees, posts, and outdoor sculptures, for example—were a second class of problems; once encountered these could be learned and avoided in the future. "Confusing architectural definitions" were another set of hazards—steps leading away from the sounds of the activities to which they eventually give access, acoustically transparent barriers such as scaffolding or poles.

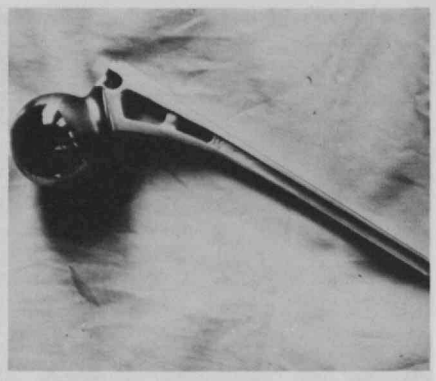
When finally manufactured, did the prototype tactual map of M.I.T. work like a map? One blind student almost immediately discovered an error: omission of M.I.T.'s sailing pavilion. Another discovered a set of steps she had not known about—they did not in fact exist. A third discovered a mail box he had needed many times but hadn't found.

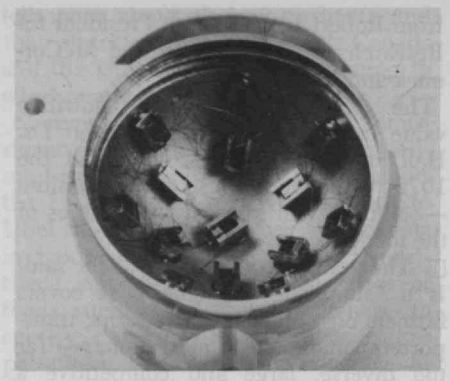
In the early stages of their research, Miss Kidwell and Mr. Greer were struck "by the almost total lack of urban maps. . . . A great need exists," they think, "for inexpensive and portable urban maps that would enable blind individuals to travel freely about an unknown city."—*J.M.*

Transmitting from the Hip

The human hip is a ball-and-socket joint, a simple engineering idea, beautifully executed. Its coefficient of friction is very low; it typically serves a lifetime without maintenance; and the loads it carries may be very large indeed.

The body's balancing mechanisms are such that if you stand motionless on one leg the forces of weight and muscle tension on that hip joint—less than 2 in. in diameter—are more than twice your body weight. When you walk, the forces on the hip joint may be five to seven times body weight—and in active sports instantaneous loads may be "a fair fraction of a ton," thinks Charles E. Carlson, a research associate who is working on prosthetic devices in the M.I.T. Mechanical Engineering Department.





In the typical hip prosthesis used by surgeons to replace the ball of the human hip's ball-and-socket assembly (left), Charles E. Carlson, Research Associate in Mechanical Engineering at M.I.T., has added 14 tiny strain gages (right). When the prosthetic device is finally used to replace a damaged human hip, a telemetering device will be added and Professor Carlson will for the first time be able to measure the forces in the human hip joint—which he says is a remarkably efficient execution of a simple engineering idea.

Little wonder that this device has attracted engineering curiosity. What can be said, for example, about how this simple ball-and-socket device handles its loads, about the strength of the materials involved, and about what these facts—if they could be found—might contribute to bioengineering in the future?

Studying the mechanical forces in the hip joint of a living human may seem an improbable assignment, but Dr. Carlson thinks he is well on the way to achieving it. His plan involves adapting some sophisticated measuring and telemetering devices to the metal ball-and-rod assembly which surgeons now use routinely to repair broken hips: the rod is implanted into the femur and the hollow ball attached to it replaces the damaged ball in the socket of the hip joint.

Dr. Carlson has machined 14 tiny thin spots—leaving 0.01 in. of metal—into the inside of the hollow ball, which is only a bit larger than a golf ball. In each is placed a tiny strain gauge, to detect the minute deflections of the thin metal during the ball's service as a hip joint. The goal is to characterize the pressure distribution which exists at any moment in time by measuring the pressure at these 14 points.

Inside the ball is a 14-channel radio telemetry device which sequentially reads each strain gauge and translates the stress into a signal which frequency-modulates a small radio transmitter. A small coil on the rod end of the hip prosthesis, which will be buried in the recipient's leg bone, receives energy to operate the system from an induction coil which the subject wears around his thigh when experiments are to be performed.

The electronics are soon to be permanently sealed and implanted into the hip of a human subject whose selection by the accident of a hip injury and the careful screening which governs all research with human subjects is yet to be accomplished.—*J.M.*

A Cleansing Beam

A $5,000 CO_2 laser could sterilize medical instruments, cleanse the air in operating rooms, and pick infecting organisms, a layer at a time, off the surface of a wound. It offers surface sterilization of materials which are too sensitive for conventional thermal methods, according to an M.I.T. electrical engineer.

The CO_2 laser beam is absorbed by moisture and therefore affects living cells instantaneously. Instruments can be sterilized quickly of even dried, heat-resistant spores (a form in which some bacteria can survive for long periods of time without nourishment or any signs of life—tetanus and botulinus survive this way, for example) and in less time of active bacteria and viruses.

George W. Pratt, Jr., Professor of Electrical Engineering at M.I.T., who is working with two CO_2 lasers—a continuous beam 50-watt tube and a pulsed 10,000-watt one—surmises that the light breaks the hydrogen bonds in cell proteins. The beam is of course deadly to human tissue, but the pulsed laser can deliver such a brief burst that only a single layer of tissue is destroyed. If the surface is constantly tested between exposures for remaining infection, the laser might be used to steadily clean a wound a layer at a time.

Laser sterilization is more practical for materials which the laser cannot harm: for the sterilization of operating room instruments that now can take up to three hours, for example. A continuous-beam 50-watt laser could ac-

complish the same cleanliness in a one-hundredth of a second. The only requirement is that the instrument to be sterilized must be manipulated in the beam so that the laser reaches all its surfaces. Professor Pratt also suggests that a small continuous laser beam reflected between two parallel mirrors placed in the ventilating system of an operating room could cleanse all the circulating air.—*J.K.*

Non-Invasive Brain Surgery

A brain surgeon's dream—the ability to perform highly accurate operations deep within the brain without cutting the overlying tissues—may soon be realized with new techniques in ultrasonics. And, similar techniques can simultaneously let him see what he is doing.

Professor Francis J. Fry of the University of Illinois at Urbana recently explained to an M.I.T. audience how such a system would work. For visualization, sound of sufficiently short wavelength (frequencies between one and 20 MHz.) can probe the brain, showing both normal and abnormal features. Such "sonar" systems are already used in a number of medical centers.

Sound waves are reflected not only by solid objects but also by interfaces of media of different acoustic impedance. As in the case of electromagnetic waves, part of the power is reflected and part is transmitted. By timing the interval between transmission of each pulse and reception of the reflected pulse or pulses, a computer (in Professor Fry's system) can produce an "echogram" picture of the structures being probed.

First, a section of the skull must be surgically removed. The patient lies with this "window" in his skull in the topmost position. A sheet of flexible plastic forming the bottom of a tank of water rests on the scalp above the window. Within the tank is a focused ultrasonic transducer, mounted so that it can scan back and forth. The water completes the acoustic path into the patient's head.

The most obvious features on the echograms are interfaces between soft tissues and fluid-filled spaces. But finer details are also visible. Professor Fry said the technique can show some abnormal features deep within the brain which cannot be shown by any other non-invasive means.

But visualizing is only half the surgeon's goal. Ultrasound at higher power densities can destroy tissues—a property which Professor Fry is trying to learn to exploit. With power densities of several hundred watts (instead of several milliwatts) per sq.cm., Professor Fry can produce in the brains of experimental animals extremely tiny and accurately-placed lesions.

These lesions can be as small as a few thousandths of a cubic millimeter; rows and columns of them can be combined to produce whatever size and shape lesion is required.—*O. Reid Ashe*

COMPUTERS

Japan Computes the Next Move

When M.I.T.'s Jerome H. Saltzer, co-head of Project MAC's Computer Systems Research Division, first visited Japan in 1966, he found that country's computing to be about ten years behind the U.S. in both hardware and software. On his next visit, in 1970, he estimated that the gap had shrunk to about five years. This year, when he went to chair a session of the First U.S.A./Japan Computer Conference and stayed to tour the major data-processing developers, he found the Japanese and Americans swimming the same waters, the Japanese perhaps a year back in software and actually a year ahead in hardware.

But some things are different. For example, the Japanese apparently do not expect the prices of large-scale-integrated circuits to fall dramatically—as is generally assumed in the U.S.—because, they say, they do not anticipate a great demand for them. Nevertheless, they see no near-term limit to the Japanese and Asian computer market—growth is expected to continue by leaps and bounds.

The Japanese national telephone company has a monopoly on remote computer services. The next such system, called DIPS, for which specifications were drawn up in 1969 (and looked rather reminiscent of M.I.T.'s Multics time-sharing system), is intended to be so reliable as to be out of service only two hours in ten years. This is viewed as a reasonably worthwhile advance over the record of today's DEMOS (comparable with the Dartmouth College time-sharing system), which has a down-time of five minutes a month. The Japanese phone company, said Dr. Saltzer, takes its computing-service role very seriously, and the operating programs of these remote-computing systems are peppered with automatic recovery routines for almost every contingency.

One major government/industry cooperative project has now come to a successful conclusion, on time: the National Computer Project, in which Nippon Electric, Fujitsu, and Hitachi all made large, high-powered multi-processor machines, comparable to the CDC-6600 in performance. Hitachi will now produce a commercial version, called the Hitac-8800.

Now there is another massive government/industry collaboration called PIPS, for pictorial information processing system. At first Dr. Saltzer encountered apparent reluctance to discuss the rationale behind putting so much stress on this particular field. Then it transpired that, having caught up with the U.S., the Japanese decided that they would like to be ahead in at least one thing. This competitive but vague desire created a difficult question: What major computer development has not yet been used in the U.S. Their answer turned out to be improved automatic pictorial processing.

This is not an unreasonable idea, on reflection, since a kind of need in this direction has been created by the Earth Resources Technology Satellite, which is producing photographs at an enormously greater rate than they can be used for anything. Dr. Saltzer draws the conclusion that Japan has no intention of opting to encourage cooperation between its computer business and that of the U.S.

Finally, one strange anomaly: The Japanese, on their overpopulated little islands, have long specialized in all forms of miniaturization—17-syllable poems, dwarf trees, multipurpose domestic architecture. Electronics conforms to the ancient pattern on the component level but not on the level of the complete computer. Japan's new high-power systems are physically huge by Western standards, their developers seemingly having "fallen behind in the packaging business," as Dr. Saltzer put it. One result is that in Tokyo there is much concern over the large areas of high-rent space that the latest computers are occupying.—*Fred Wheeler*

The Disaster Area

"Software"—the program of instruction by which an engineer tells a computer what to do—has been the "disaster area" of the computer business ever since the 1950s, when the first large digital computers were ready to go to work.

It still is.

Why has the software record been so dismal?

A series of reasons, said M.IT.'s Malcolm M. Jones, Assistant Professor of Management, at a seminar of graduates of the Sloan School of Management to celebrate its 20th anniversary this fall:

☐ It's a labor-intensive activity; there is literally no way—at least not yet—to substitute machines for people on

this job. The trick, instead, is to substitute people for people. It's now recognized that there are good programmers and then there are the rest of us. A good programmer may work three times faster than an ordinary one, and the program he writes may achieve the same result while using as much as 60 per cent less computer time.

☐ Software is all development; there are no prototype or manufacturing stages, no ways to build a sample and then go back to make the real thing. So organize small teams of expert programmers to work on each part of the job, and let each team check what another does.

☐ Write software so that it can be rewritten to accommodate change. One of the difficulties is that software projects may last a year or more—and it's easily possible for a program to be obsolete before it's written. An example: programs for the Apollo lunar orbits were well underway before the moon's gravitational anomalies—called mascons—were discovered, and considerable rewriting was required.

The cost of software goes up—perhaps geometrically—with the complexity. Something like $20 per machine instruction is "not outrageous" for a large program, said Professor Jones. This was about the cost of early Air Force ("Sage") and N.A.S.A. programs, but the complex programs for Apollo were, he believes, more nearly $200/instruction.—*J.M.*

In Favor of Comprehensibility

"In the mid '60s, something terrible happened: the computers of the so-called third generation made their appearance. The official literature tells us that their price/performance ratio has been one of the major design objectives. But if you take as 'performance' the duty cycle of the machine's various components" (i.e., the work that actually occupies the components' time) ". . . the major part of your performance goal is reached by internal housekeeping activities of doubtful necessity. . . .

"When these machines were announced and their functional specifications became known," continued the Dutch computer programming expert Edsger W. Dijkstra, as he received the highest annual award of the Association for Computing Machinery, "quite a few among us must have become quite miserable. . . . Such machines would flood the computing community, and it was therefore all the more important that their design should be as sound as possible. But the design embodied such serious flaws that I felt that within a single week the progress of computing science had been retarded at least ten years."

Dr. Dijkstra (of Eindhoven Technological University's Mathematics Department) has clearly not changed his opinion. There are many, he told the A.C.M. audience at this summer's annual meeting in Boston, who believe that, since the third-generation machines have been sold in large numbers "the design cannot have been that bad." This was like saying "that cigarette smoking must be healthy because so many people do it." He regretted that it was not customary to publish reviews of new computer hardware, in the same way that books are reviewed. He had in fact written such a review in the '60s but had been afraid to submit it for publication—"an act of cowardice for which I blame myself more and more." The appearance of such reviews "would be a sure sign of maturity of the computing industry."

As to why a software authority such as himself should speak on the faults of computer hardware: "one of the most important aspects of any computing tool is its influence on the thinking habits of those that try to use it . . . I have reasons to believe that that influence is many times stronger than is commonly assumed."

Programming languages too have such an influence. One programming language generally regarded as a major advance is the "high-level" language PL/1. (For example, M.I.T.'s time-sharing project MULTICS is programmed in PL/1 as far as possible, "to maximize lucidity and maintainability," according to a recent seven-year progress report.) Dr. Dijkstra finds the documents which define Pl-1 "frightening" in their size and complexity. "I absolutely fail to see how we can keep our growing programs firmly within our intellectual grip when by its sheer baroqueness the programming language —our basic tool, mind you!—already escapes our intellectual control." In its influence upon its users, he compared PL/1 to a drug, and cited the example of one enthusiast who, in the course of a single lecture "managed to ask for fifty new 'features', little supposing that the main source of his problems could very well be that it contained already far too many 'features'. The speaker," Dr. Dijkstra reported, "displayed all the depressing symptoms of addiction, reduced as he was to the state of mental stagnation in which he could only ask for more, more, more. . .".

This year's winner of the A.M. Turing Award then presented his vision of the future. He suggested "that we confine ourselves to intellectually manageable programs." Some might fear that this would be an intolerable restriction, but he believed that a great deal of useful work could be done with programs that could be grasped as a whole. Among the advantages of comprehensibility would be an escape from the present need for purely trial-and-error debugging: "Program testing can be a very effective way to show the presence of bugs, but is hopelessly inadequate for showing their absence." A comprehensible program, he said, can be shown to be correct by logical proof (by starting with a proof, and writing the program to conform to it).

In a modern computer, a single operation may take on the order of a millionth of a second; while programs are written which, in all, take several hours of machine-time. In nature, such a range of scales (ten orders of magnitude) always comprises a hierarchy of entities, each comprehensible in its own way: particles, atoms, molecules, crystals, and so forth. A large computer program should be treated in the same fashion—as a multi-level hierarchy—said Dr. Dijkstra: not, that is, as a formless succession of details.

Creating such programs, comprehensible at each level of organization in terms of their lower-level component programs, will be a unique challenge, he added. "This novel experience can teach us a lot about ourselves. It should deepen our understanding of the processes of design and creation, it should give us better control over the task of organizing our thoughts. If it did not do so, to my taste we should not deserve the computer at all!"—*Fred Wheeler*

TRANSPORTATION

The Lower, Slower, Smaller Airliner

There are in the United States about a hundred "commuter" airlines. Most of them employ less than 50 people and have sales of less than $1 million. They fly to small cities with aircraft of about 15-passenger capacity. If such an aircraft has more than five people aboard —that's a load-factor of above 33 per cent—it is probably breaking even.

Kingsley G. Morse, who runs Command Airways out of Dutchess County Airport near Poughkeepsie, N. Y., previously worked for five years with American Airlines, mostly in scheduling and planning. He recited these figures to an M.I.T. audience last fall, to demonstrate why it is that his operation barely survives. He emphasized that Command Airways was established for profit, not as a tax shield.

"So why do you do it?" was the natural question, seeing that it is evidently very hard work. Mr. Morse replied, rather diffidently, in terms of the Puritan ethic and so forth, but it was clear that operating half a dozen

small aircraft simply is a life that some people greatly enjoy.

The commuter airlines are growing as the "feeder" lines retreat from towns too small to provide profitable loads for their (middle-sized) equipment. In 1966, when Mr. Morse founded Command, he began by studying the business that New York City's air taxi companies did. There proved to be a sizable demand for regular flights into New York from distances beyond a two-hour car journey; reliability was critically important to the businessmen who constituted this demand, but cost was not.

Today, Mr. Morse reports that it is possible to provide the safety, dependability and courtesy that his clientele requires without actually losing money (as many commuter lines do). But he would be happier if the Civil Aeronautics Board did not control his prices, since he is not competing with equals who provide similar services. He believes in attention to detail, guided by a daily review of happenings and a monthly passenger questionnaire.

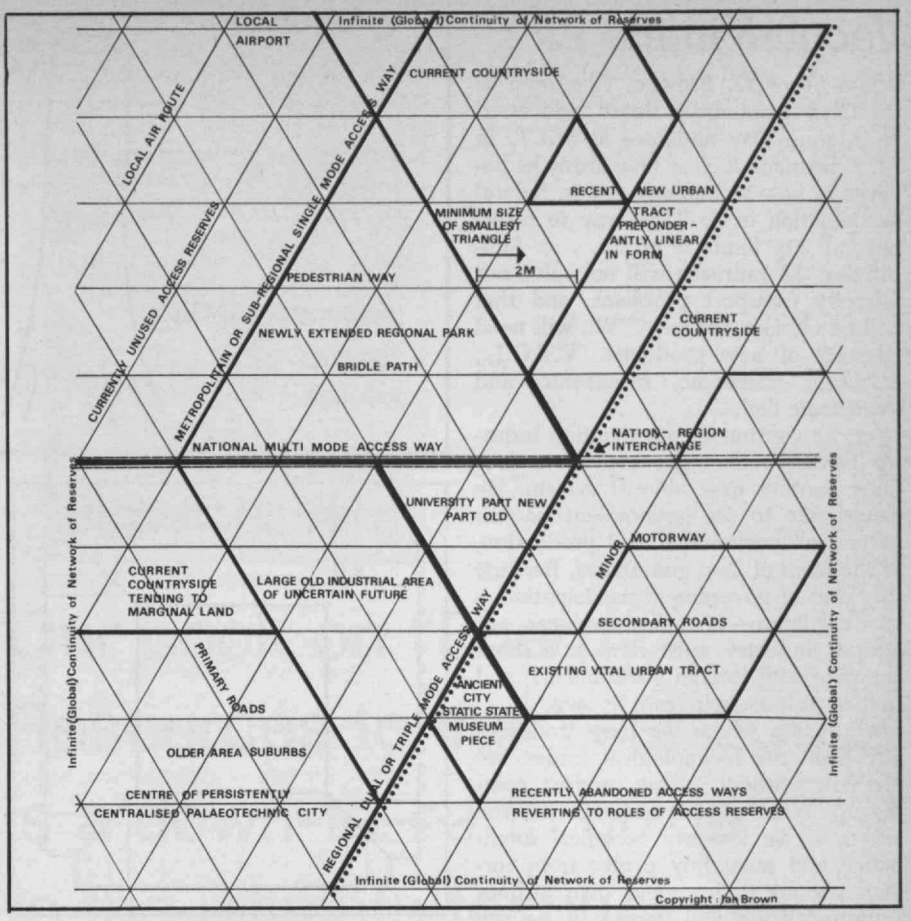
He does not approve of government subsidy of operations, but he considers that the Department of Transportation could usefully support either the development of a 30-passenger commuter plane or its purchase. Why 30-passenger? Well, traditionally airliner capacity has grown in steps of a factor of two. (In fact, Short and Harland is now working on a 30-passenger commuter airliner, the SD-3-30.)

Will the commuter companies merge, for economic survival? Hopefully not; there is, according to Mr. Morse, a best size for an airline—six planes, 60 employees—above which enthusiasm wanes.—*Fred Wheeler*

Flexibility Through Monotony

Our built-up environment is shaped by our transportation. Cities reach forth their suburban tentacles, following the asphalt skeleton. Airports attract light industry; railways bring factories and slums. Our limited ability to re-shape this environment is demonstrated every time anyone tries to build a new transportation facility, be it an expressway, a rapid-transit line, or an airport. The man who still controls access to the city is the man who first laid out the roads.

One quality the urban planners fail to design for, even in the newest "new towns," is flexibility, believes Ian Brown of the Greater London Council and the School of Architecture and Urban Planning at Princeton University. They plan a region and its access ways



A network of "access reserves," instead of fixed roads, could provide a flexible framework for a region's transportation, provided society were prepared to accept it aesthetically. It would be an infinite patchwork of equilateral triangles, which turns out to offer far more variations that the conventional grid of rectangles, thinks Ian Brown of the Greater London Council and the Princeton School of Architecture and Urban Planning.

either with a grand, rigid geometrical pattern, or with a randomized, but still just as rigid, "ripple finish." Either way, the access ways are fixed and there is no provision for augmenting them in the future.

At the International Conference on Transportation and the Environment held in Washington, D.C., early this summer, Mr. Brown proposed instead the notion of "access reserves." There would be no single grid of completed streets and roads, but a grid of rights of way, which could be used or abandoned as needed. Any single element in the network "may sometimes, throughout say any century or half-century, contain a real and active access, sometimes not; or contain sometimes a major, multi-modal access, sometimes a minor, perhaps single-mode access." Any pre-existing urban units would become nodes in such a network, which "can accommodate growths and declines, shifts of access importance, shifts of focal, areal, or activity importance."

For the form of the grid, Mr. Brown proposed an infinite patchwork of equilateral triangles. The strength of the triangle for this purpose is its flexibility: "This fundamental component can arrange itself linearly, in rows; or in rows of rows, inside itself as parent or outside of its smaller versions in infinite array and diversity; or, and concurrently, it can form into centrally inflected polygons of more complex form, most multi-symmetrically. . . ."

One serious problem, he admitted, is aesthetic. Transportation at present is seen as a visual intrusion upon our aesthetic tradition. This "picturesque" tradition "abhors largeness of size in towns or cities, over-extensive horizontal continuities, over-extensive regularities, horizontal or vertical. It abhors uniformity, and therefore standardization of parts."

Before society can accept the "access reserves" proposal, Mr. Brown believes it will have to "divest itself of the hegemony of the aesthetic of the picturesque, and replace it with a totally new aesthetic." We must abandon our craving for visual variety and boundedness, and adopt "an aesthetic of continuity, of sameness, of infinites, of endless horizontal straight lines."

Mr. Brown allowed that the change-over would be difficult.—*O. Reid Ashe*

Vacuum in the Air?

When Secor D. Browne, Chairman of the Civil Aeronautics Board, addressed an Alumni Day audience at M.I.T. in 1972, he made it clear how firmly he believes in new technology and in federal participation in it: "The way to travel beyond city limits is by air. . . . Subsidizing the railroads will not solve our intercity transport problems, and that will be obvious ere long." We will need all sorts of new products: "V.T.O.L., S.T.O.L., transsonic, supersonic, and hypersonic flight."

Yet, he continued, our aviation industry cannot collect the capital to produce another new aircraft system. He would like to see government participation in development and production, in the form of loan guarantees. Because this kind of government participation—at a minimum—is typical overseas, our aircraft industry must now in a sense compete with foreign governments; and so it must have help from its own.

In an area where we have traditionally been the technological leader, we are now without a new product coming up. What will happen, Mr. Browne asked, if we lose our technical dominance and must buy planes from foreign makers to keep our own airlines running? What will happen if we are at war and need parts?

He has proposed to Congress, he said, "a sort of 'aerospace reconstruction finance corporation' through which the government would underwrite future development costs." The program is "extremely critical," he said, "and I would be grateful if you wrote your Congressmen."

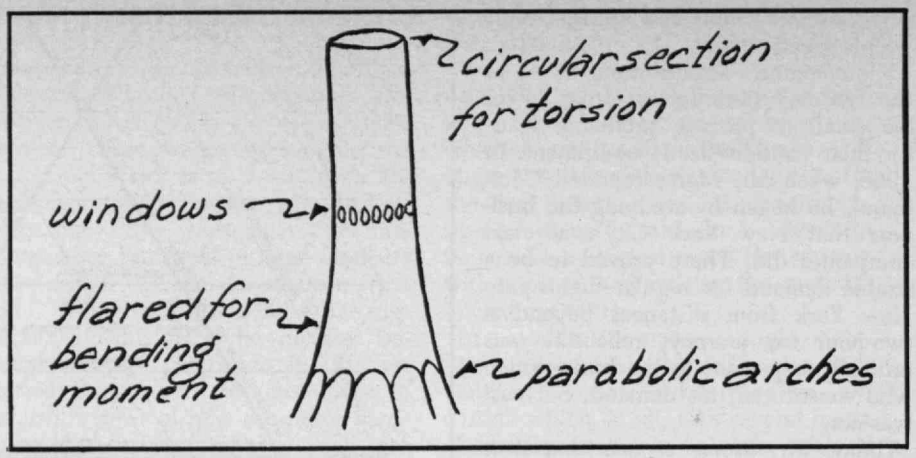
Of the newest technical achievement in aviation, Mr. Browne said (responding to a question): we neither "could or should try to keep the S.S.T. out. We will have our own second-generation S.S.T." The Concorde will not cost $60 million, as quoted by one of the parties to its sale, he said, but only $31 or $32 million. The important figure is in any case not what the plane costs but what it will earn, and in this respect an S.S.T. (when we get it) will, he does not doubt, be satisfactory.

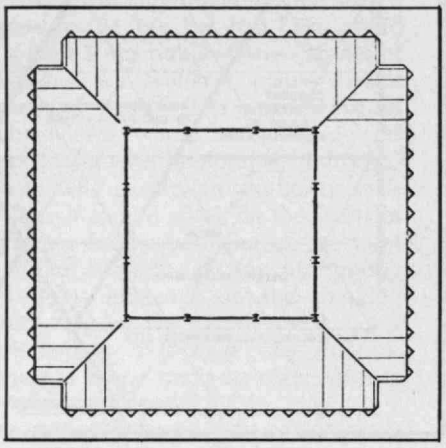
Believing that the airplane must be a good neighbor, Mr. Brown added, he has always held that "we will never operate the S.S.T. over the heads of an articulate voting population. But there are large areas of the world where it can be flown."—*J.K.*

STRUCTURES

Building a Tube

When the Standard Oil Company (Indiana) moves to its new 86-story headquarters building in Chicago early next year, its executive functions will be in a framework which hides some complex innovations. For the Standard Oil Building is in fact a tube standing on end—one of the simplest basic structural forms.





When he learned that Standard Oil Company (Indiana) was planning a new headquarters building in Chicago, E. Alfred Picardi of Perkins and Will started with this sketch (above) of an idealized "tube" building. Edward Durell Stone and Associates and the Perkins and Will Corp., associated architects, developed the final building form utilizing the concept of this uniquely simple structural system, and computer-aided design studies at M.I.T. helped to confirm its feasibility. The floor plan (left) shows how chevron-shaped vertical members are linked to effectively form a rigid tube.

The first "tube" skyscraper in the U.S. was Standard Oil's Chicago neighbor, the 100-story John Hancock Center (*see* Technology Review *for July, 1967, p. 38*). Thinking about that structural design in retrospect, E. Alfred Picardi, who had been Chief Structural Engineer in the Chicago office of Skidmore, Owings, and Merrill building the Hancock Center, began to visualize the ultimately simple solution: a single tubular "chimney" of steel, flared at the bottom for stability and rising as high as needs require. Cut windows and surround them with the metal removed from the window hole for reinforcement.

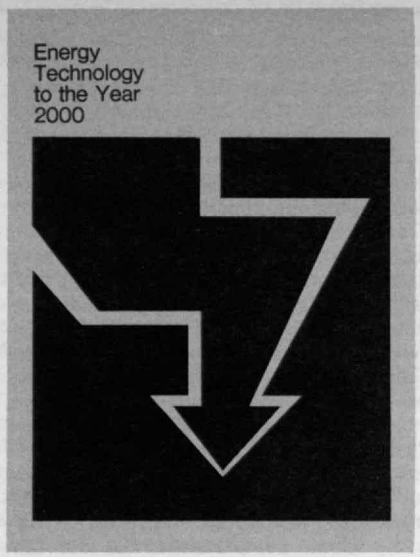
Such a round tube is in fact the ideal shape for a high-rise building, because it presents no torsional problems and few fabrication problems, Mr. Picardi told a building systems conference of the National Science Foundation and the American Society of Civil Engineers early this year. He even made some sketches in 1969 and 1970—and when the Standard Oil Building came along, those sketches became the structural scheme presented to Edward Durell Stone and Associates and the Perkins and Will Corp., associated architects for the building. (Mr. Picardi was by then Vice President of Perkins and Will.)

The building as finally designed is far from circular; it is, nevertheless, a tube: the faces of the building form the sides of the tube, perforated to provide windows; and the floors provide rigid diaphragms, stabilizing the exterior walls.

M.I.T. students and faculty participated in testing the feasibility of the design. They worked with Perkins and Will engineers and other consultants to develop a series of gradually more detailed computer studies of the structural system. The major portion of the conception, analysis, and design of the building was completed within nine months, according to Robert J. Hansen, Professor of Civil Engineering.

The design finally called for just over 50,000 tons of steel in the structural frame, 31 lbs./sq. ft. of floor area. Among the very tall buildings only the 100-story Hancock Center in Chicago has a comparable light-weight frame.

Another result was a special by-product for M.I.T. students. During the design period in 1970-71 many graduate and undergraduate students not only watched and indeed participated in the design process, but heard "all of the major actors in the project from owner to constructor" who came to give lectures and seminars at M.I.T.—*J.M.*



Contents of "Energy Technology to the Year 2000":

"Energy, the Economy, and the Environment," David C. White, Ford Professor of Engineering, M.I.T.

"Electric Power from Nuclear Fission," Manson Benedict, Institute Professor (Nuclear Engineering), M.I.T.

"Geothermal – Earth's Primordial Energy," Richard G. Bowen and Edward A. Groh, Oregon Department of Geology & Mineral Industries

"Must Fossil Fuels Pollute?" Harry Perry and Harold Berkson, Congressional Reference Service, Library of Congress

"Heat – the Ultimate Waste," Donald R.F. Harleman, Professor of Civil Engineering, M.I.T.

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"The Quest for Fusion Power," Lawrence M. Lidsky, Professor of Nuclear Engineering, M.I.T.

"Creating Power Plants," William W. Lowe, Pickard, Lowe and Associates

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(Book Reviews continued from p. 11)

verted, by the massive underground weapons testing carried out by both sides, into a hollow mockery of arms control.)

I suppose the most exciting Pugwash ventures have been those into high politics, where the prospects were slimmest but the stakes were highest (and objective evidence as to their usefulness most difficult to obtain). For example, consider the exchanges between Russian and American scientists, via Rotblat in London, in the earliest, most crucial days of the Cuban missile crisis, in an attempt to avert a head-on confrontation between Russian ships bound for Cuba and American naval vessels setting up a blockade; we'll never know whether these interventions helped to cool official tempers and to slow down the pace of the confrontation. Or take the mission of two French scientists to Hanoi, in the early fall of 1967, at the instigation of another private Pugwash meeting, this time in Paris, in June, 1967 (taking advantage of Kissinger's presence there) out of which eventually emerged Johnson's "San Antonio formula" for stopping the U.S. bombing and stating the negotiations; was this the crucial contact among the many then being attempted? How can we ever know?

But, if less spectacular, certainly in the long run the most essential for ensuring the survival of mankind has been the steady development, through mutual education and the concomitant growth of sophistication, of a workable approach to controlling the nuclear arms race that is finally bearing fruit at the S.A.L.T. negotiations. This has required patience, persistence, and all the skills that could be mustered by some of the outstanding scientific intellects of this age—men like Leo Szilard and I.I. Rabi from the U.S.A., Igor Tamm and Peter Kapitza from the U.S.S.R., C. F. Powell and P. M. S. Blackett of the U.K., Francis Perrin of France, Vikram Sarabhai of India, Hideki Yukawa of Japan—great men all, but with the special quality of human greatness to match the intellectual.

Progress has been slow and frequently painful; but humanity has always prevailed in the discussions, as it must in the end prevail on the international arena if mankind is to survive.

The Courage To Say "Da!"

Privileged, as I have been, to attend most of these Conferences, many incidents and scenes come to mind to illustrate this special Pugwash quality. But space permits only one brief anecdote. It occurred, I believe, at the Eighth Conference, in Stowe, Vermont, in September, 1961, which took place only very shortly after the "breaking" by the Russians of the unofficial moratorium on nuclear weapons tests. The fact that the Russian group was able to come at all was already a very important sign of the high regard with which this channel of communication was held by the Russian scientists and their government.

But the discussions were very tense, especially on the question of the future prospects for a nuclear test ban treaty. Many were so pessimistic that they were ready to give up; but others felt it might still be possible to make a fresh start. After long, sometimes acrimonious discussions, a proposal containing a specific suggestion that could have made it possible to renew the testing moratorium was on the floor. (The details elude me, but they are not important for my point.)

The Russians—already defensive on the subject and smelling some kind of a trap whereby their agreement to the value of resumption of the moratorium would imply admission that their government had been wrong in ending it—were clearly in a quandry. Just at this point, Leo Szilard, who had been sitting among the Russians (Leo liked to sit with the Russians because, when the sessions got dull, he had in them an appreciative audience that had not yet heard his latest jokes), piped up with a clear "da" (yes), which completely broke the tension. From that point on, that particular group was able to get on with its task of devising a mutually acceptable approach that helped put the test ban negotiations on the track again.

The courage to say "da," when all the pressures around you are insisting on "nyet," is what Pugwash is all about. If you read carefully between the lines, you'll find many other examples in Professor Rotblat's history; it's worth the effort.

Investing Made Easy

Book Review:
Jerry E. Cook

Investing in Japanese Securities
John B. Bennett and Norman Doelling
Charles Tuttle Co., Rutland, Vt.,
and Tokyo, Japan, 110 pages, $3.00

Only two days after my copy of *Investing in Japanese Securities* arrived, the Japanese government temporarily suspended the purchase of Japanese stocks by foreigners. This is in fact evidence of the timeliness of the book by John B. Bennett and Norman Doelling (M.I.T.'53) —not its obsolescence. For the suspension of foreign investment is but a temporary stage in Japan's attempt to curb the inflow of foreign money, which is helping to force an upward revaluation of the yen; the investment opportunity will soon return.

The authors do not propose a single set of techniques or strategies for investing in Japanese securities. They simply hold the notion that Japan has fundamental advantages and that her growth is essentially certain to exceed that of the U.S. The devaluing of the dollar and upward revaluing of the yen which gave a 16 per cent increase in the purchasing power of the yen during the fall of 1971 continues to attract investors. Likewise, Japan's trade surplus with the U.S. is now projected at $3.9 billion for 1972 and is certain to result in another 10 per

Tokyo Stock Prices Hit Another Record In Frantic Session

Special to THE WALL STREET JOURNAL

TOKYO—Japanese stock prices mounted to another record in a second day of frantic trading on the Tokyo Stock Exchange Wednesday.

To give brokers a chance to cope with the soaring volume, exchange authorities canceled trading sessions Thursday afternoon and Saturday morning.

In Wednesday's hectic trading, the 225-share index, a widely watched barometer of Japanese stock prices, jumped 47.77 points to close at a record 4,602.78. At one point it had been more than 60 points, but a spate of profit taking in the afternoon trimmed some of the gains. The exchange's own index rose 1.74 points

Even as this issue of the Review was being prepared for the press, the Wall Street Journal *made clear the timeliness of an essay on Japanese investment opportunities.*

cent revaluation of the yen by early in 1973.

However, even excluding currency adjustments, Japanese stocks have faired well. Between 1965 and 1970 an investment in those stocks comprising the Tokyo Dow Jones average appreciated 80 per cent while those of the New York Dow Jones gained only 15 per cent.

Japanese firms enjoy a climate for growth unknown in the United States. First of all, the home market is extensively protected by duties, quotas and an internal distribution system that is very expensive for imported goods. For example, a Ford Ltd. costs $14,000 in Tokyo, while Toyotas cost $2400 in Los Angeles. Even Sunkist oranges are 65 cents each, and a good steak costs $9 per pound.

Productivity gains also favor Japan. For example, when the newest Nippon Steel Corp. plant becomes operational it will require only two man-hours to produce a ton of steel. At an average wage of $2.50 per hour, that works out to $5 per ton. In the U.S., 11 man-hours are required per ton at a labor cost of $7 per hour.

Unlike western Europe and the U.S., labor union and industrial relations policies in Japan favor productivity gains. Companies are obligated to their employees for lifelong jobs and consider labor a fixed cost. On the other side, unions are organized by company and make no wage differentiation by job skill. Further, unions relate their wage demands to each company's success. To protect themselves, companies use subcontractors whenever possible, and semiannual bonuses which can be reduced if business is bad comprise 30 to 50 per cent of total earnings. Hence to both worker and his company higher productivity means more bonuses, further growth, and a more competitive position without fear of fewer jobs.

High technology is also very much in Japan's future; aircraft, computers, and nuclear development are the priority areas. The government forces foreign companies into joint ventures or licensing agreements to gain needed technology while protecting the home market through tariffs, and government funds are funneled to these "sunrise industries."

The investor in Japanese stocks can profit even more directly from government involvement. During the 1960s there was a severe decline in the Japanese stock market, and the government formed two corporations that purchased securities worth billions of yen to stabilize the market. These corporations later resold their holdings and were dissolved.

The principal sour note to the American investor is the Interest Equalization Tax imposed by the U.S. government on the purchase of foreign securities; its effect is to force the investor to think more of long-term gains. But this tax of 11.25 per cent of the purchase price is applicable only the first time shares are bought with U.S. funds; it does not apply to transactions involving investments previously owned by a U.S. investor.

In a time when every day's news records a worsening of the U.S. trade position and greater triumphs for the Japanese economy, an investor with an international viewpoint cannot help but outperform those who restrict themselves to the U.S. market.

Jerry E. Cook is a student of Japanese business who makes his home in Tokyo.

Superior Scholarship, Superior Texts

CITIES AND GEOLOGY
Robert F. Legget, former Director, National Research Council of Canada 1973, 460 pages (tent.), (037062-1), $14.50 (tent.)
The explosive growth of urban areas in recent decades has generated a tremendous interest in the problems of cities. Yet all too often these problems are approached with little or no knowledge of subsurface geological conditions. CITIES AND GEOLOGY utilizes examples, illustrations, and case histories from around the world to demonstrate the significance of geology in solving problems of urban growth. Designed for courses in urban or environmental geology, environmental studies, and city planning/urban development, the text includes over 400 references to the literature of geology, engineering, and planning.

PRINCIPLES OF ENVIRONMENTAL SCIENCE
Kenneth E. F. Watt, University of California, Davis
1973, 319 pages, (068575-4), $10.95
Existing texts in the field of environmental science too often focus on numbers of events, descriptions of situations, and specific causes and effects without providing the conceptual framework necessary for proper assimilation of this information. PRINCIPLES OF ENVIRONMENTAL SCIENCE provides a completely new theoretical orientation for this increasingly significant subject. Although extensive reference is made to existing literature, a great deal of the text material and many of the illustrations and photographs were developed especially for this book. Assuming no college-level science or math background, the book relies on charts, diagrams, and photographs to convey abstract ideas.

CONCEPTS AND MODELS IN GROUNDWATER HYDROLOGY
Patrick A. Domenico, University of Illinois, Urbana/*International Series in the Earth and Planetary Sciences*
1972, 416 pages, (017535-7), $14.50
Presents the main ideas of groundwater hydrology, grouping various hydrologic models and concepts into two general categories: lumped-parameter and distributed parameter systems. Each of these groupings is treated in a separate section, while an additional section deals with conservation principles and applications.

ENVIRONMENTAL PROTECTION
Emil T. Chanlett, University of North Carolina at Chapel Hill
1973, 608 pages (tent.), (010520-0), $14.50 (tent.)
A Problems and Solutions Manual will be available.
This man-centered text describes the rationale for the management and protection of our land, air, water, and energy resources. The consequences of mismanagement of the major environmental components are examined at three levels: (1) effects on health; (2) effects on comfort, convenience, efficiency and esthetics; and (3) effects on the balance of ecosystems and of renewable resources. Although scientific and engineering accuracy are stressed, the material covered is presented in a clear, non-mathematical manner.

ENVIRONMENTAL ADMINISTRATION
Stahrl W. Edmunds and John Letey, Jr., both of the University of California, Riverside/*McGraw-Hill Series in Management*
1973, 480 pages (tent.), (019023-2), $11.50 (tent.)
With an introduction by Paul R. Ehrlich. The problems and criteria of environmental improvement are defined clearly so that students and practitioners alike can see how to implement decisions for enhancing environmental quality. Basically this is a systems approach to deciding environmental problems. As such it concentrates on the information flows about the environment required to make decisions about environmental quality.

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Of Beans, Bananas, and Brutalities

Book Review:
Janet Kreiling

In the Shadow of Man
Jane Van Lawick-Goodall
Houghton Mifflin Co., Boston, 1971, 297 + xx pp., $10.00

Ten years ago, late one afternoon, a young English woman walked carefully through the forest on the eastern shore of Lake Tanganyika—trying again to approach a group of chimpanzees she had followed for many months. She reached where the four had been, to find—again, her heart began to fall. But this time the four had seen her come and had not fled. Of the moment she wrote: "Without any doubt whatsoever, this was the proudest moment I had known. I had been accepted by the two magnificent creatures grooming each other in front of me. I knew them both—David Graybeard, who had always been the least afraid of me, was one and the other was Goliath, not the giant his name implies but of superb physique and the highest ranking of all the males. Their coats gleamed vivid black in the softening light of the evening."

Jane Goodall spent most of ten years at the Gombe Stream Chimpanzee Reserve with first her mother, then only a few African helpers, then her sister and a European assistant or two, then the photographer whom she married, then the tribe of chimps, and then her son. Her camp grew from one tent to a small complex of aluminum buildings. She shared with the troupe of chimps their births, their childhoods and adulthoods, their exultant rain dances and their joyous play, their shivering cold nights in rainy season, their rites of passage, their deaths. She saw the bewilderment of a mother whose newborn was the first to die of an epidemic of polio; she saw the withering of a child whose mother died; she saw a balding old mother begin again to play as her newest baby learned; she saw a young male persistently and intelligently displace Goliath as dominant male (by clattering kerosene cans); she saw how ineptly an adolescent male cared for his baby brother; she saw the ritualized displays of aggression and the pats and reassurances that always followed them.

It was a great adventure. And an arduous one: Miss Goodall lived at the Reserve on bread, beans, tinned meat, coffee—and bananas. After several years, she and Hugo Van Lawick (her photographer-husband) finally began to stop work one night a week at dusk; to this one evening, she writes, they looked forward as some people do to weekends.

Her relationship with her chimps is respectful and affectionate. No one before had made careful study of these intelligent primates in their home lands, so her scientific discoveries are original and exciting. She discovers, for example, that chimpanzees kill and eat other animals—that early find helped persuade the National Geographic Society to continue its support. She observed impressive instances of chimps not only using but making tools such as termite-sponges and fishing rods. She observed chimps conniving to get their own ways—and succeeding. A bored young male, for example, repeatedly kidnapped his baby brother to lure his mother away from termite-fishing.

She observed also the range and expressions of emotions in chimpanzees. Like us, they fear, they make lifelong friendships, they get angry, they look for warmth and comfort from each other, they are joyful and playful. They do not love, male and female, as we do. How Miss Goodall has learned—by gently and sympathetically making herself part of the chimpanzees' world—makes clear the questions I could not quiet after the report made last winter to the meeting in Philadelphia of the American Association for the Advancement of Science by Allyn Deets (of the Laboratory of Clinical Science at the University of Pittsburgh) and Harry F. Harlow (of the Primate Laboratory at the University of Wisconsin—Dr. Harlow is famous for his observations of the newborn monkeys separated from their mothers and placed with wire or cloth covered mother substitutes.)

In the experiments which Drs. Deets and Harlow reported (conducted by themselves and others), newborn rhesus monkeys were completely isolated in laboratory cages for 3, 6, 9, or 12 months and then placed again with other, normally reared, monkeys; or 6- or 12-month old monkeys were placed in isolation for varying periods, then to rejoin their fellows; or monkeys spent their entire lives in partial isolation from which they could see and hear but not touch their fellows. They believe that the emotions in a human or a primate appear in a definite sequence as he grows: affection first, then fear, then aggression, for example. (This can be observed in human children.) They believe this sequence is directed by a maturing body and that these emotions are innate.

"We are concerned," they said, "that social scientists, in their rush to reject [previously discussed] simplistic biological models of human aggression, may throw out the baby with the bath water, prematurely disregarding the powerful contributions of innate factors in primate aggression. . . . The search for understanding ends with the identification of learning processes and situational variables."

They threatened, therefore, isolated monkeys either by showing them pictures of grimacing adult monkeys or by rubbing objects against their cages. Other isolates, not so threatened, were returned to group life. They proved that even an isolated monkey showed no fear until he reached 3 months of age, and then it appeared almost overnight. They proved that the response to his fear made by an isolated monkey was abnormal: "They viciously bit and tore their own flesh, and vigorously flailed their head and limbs against parts of the cage. . . . the large canines of maturing male isolates frequently must be removed to prevent the animals from goring themselves to death. At the Pittsburgh laboratory one adult isolate even managed to partially blind himself. . . ." One 3-month old infant—a lucky one, perhaps—died of shock. Another was force-fed and kept alive.

If the isolated animals were placed again in monkey society, they attacked inappropriately—"brutal beatings" of defenseless year-old normal infants were common. Females who have been isolated will not willingly mate—they conceive upon the "rape rack" or by artificial insemination. Nor will they mother. Of 38 such mothers, 5 killed their babies and one maimed it so seriously the investigators removed it. Among the others, "brutal and beastly abuse" was "relatively common."

What Drs. Deets and Harlow have found are the types of abnormal social aggressive behavior to be developed when rhesus monkeys are reared in total or partial isolation for varying lengths of time. They have found the longer the time, the more damaged the individual; they have found that if an animal is isolated during the time when a given emotion is maturing, his expression of that emotion will be abnormal. Thus, an infant reared normally for six months will show normal responses of fear and affection, but if then isolated for six he will be highly aggressive.

"We believe," Dr. Deets told the A.A.A.S. meeting, "that these findings provide strong support for our proposals concerning the maturation and differentiation of the agonistic emotions [fear and aggression] and the importance of the individual's social learning experiences during the period when these emotions are maturing."

Dr. Goodall writes of chimpanzee orphans. Of one especially, Merlin, whose mother died when he was still nursing—he was three years old—she writes: "Gradually, as the weeks passed, Merlin became more emaciated, his eyes sank deeper into their sockets, and his hair grew dull. . . . He became increasingly lethargic and played less and less frequently with the other youngsters." Merlin lived for several more years, forgetting how to fish for termites, trying constantly to ingratiate himself with older males, lying listlessly upon the ground. One year he began to play again "but as soon as one of his playmates got rough Merlin still either crouched squealing in submission or else turned and hit out aggressively." Not long after that he died of polio. Other orphans do not live so long; all show the same growing neuroses and physical wasting. Dr. Goodall reports other youngsters growing up to show abnormal behaviors that she can correlate with a mother's neglect or old age.

Dr. Goodall learns how her chimps demonstrate their feelings, she learns how differing conditions in childhood affect how an individual matures. She writes many times of the importance of grooming—physical comfort—to the health of the chimps. She has learned, as much as it is possible for another species to learn, of the life and society of wild chimpan-

zees. Drs. Deets and Harlow have learned what abnormal emotional responses result when a monkey is raised in an abnormal environment and that during one period of his life—from 3 to 18 months of age—isolation irreparably damages his responses of and to fear and aggression.

I question if what they have learned could not be learned by the natural and kindly method of Dr. Goodall. I question, even if information of value is so obtained, whether we have the right to condemn another animal—and especially one whose emotions are so evident and so strong—to the years and lives of cruelty that they report.

Ever Tried a Cross Number Puzzle?

Puzzle Corner:
Allan J. Gottlieb

I have been nearly deluged by first-time responses—people who read the column but have never written me before—in response to our offer in October/November. I called the Editor to ask him how many gifts he was prepared to send. He said that he expected I would receive perhaps six or eight letters; I told him I already had five times that many and they were still coming. He was delighted, but I thought he sounded a little worried, too . . . Every first-time respondent was to receive a gift; was he worried about a few dozen extra Christmas presents?

From now on, if the proposer of a "speed" problem submits a solution with the problem, that solution will appear at the end of the column in which the problem is published.

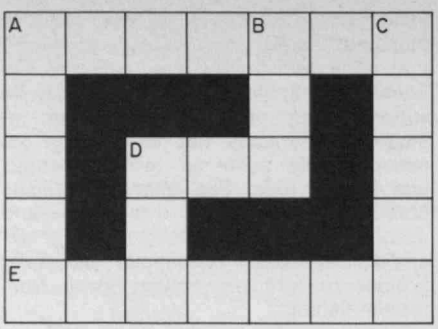
Problems

This month we begin with a chess problem from Alan La Vergne, which he credits to his M.I.T. classmate Robert Wolf:

JA1 A game of chess has just concluded, leaving (after Black's last move) White's king at his K1 and Black's king at his KR5 (White's KR4). Black, out of whimsy, asks if he can have his last move back. White, never one to give something away for nothing, says all right, if *he* can have his last move back too. Black agrees and takes back his last move. Then White does the same and makes another move, whereupon Black moves and gives checkmate. Problem: find the moves.

Here is a novel problem from Harry Nelson, a cross-number puzzle. He explains that it is quite like a crossword puzzle, with clues across and down, but the clues are about numbers and the blanks are to be filled with digits. Each square is to contain a single decimal digit; for example, A across is a seven-digit number.

JA2 Each of the letters in the clues (R, S, T, W, X, Y, and Z) stands for a decimal integer which may have many digits. The problem is to find numbers satisfying the equations in the clues and properly filling the blanks.



Across:
A = R! + S
D = X − Y − Z − Z
E = W^W/T

Down:
A = T^S
B = X + X + X + X
C = X + X − Y
D = Y

This problem is from James C. Wilcox:

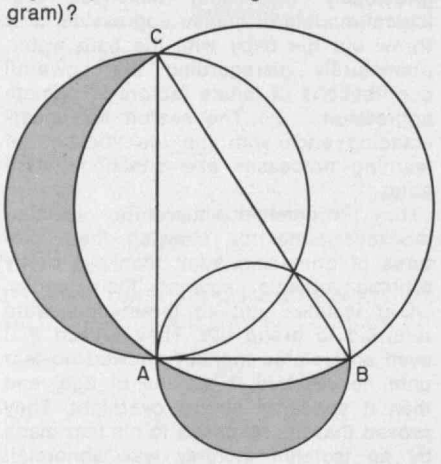
JA3 Four observers N, E, S and W depart the center of an unaccelerated two-dimensional cartesian coordinate system at the same time with equal, constant speeds. N and S travel in the direction of the positive and negative y axes while E and W travel in the direction of the positive and negative x axes, respectively. N directs a ray of light toward E who reflects it with a mirror to S who reflects it to W who reflects it back to N. Each observer measures the angle between the directions of propagation of the received and transmitted rays with a theodolite. They all find the same angle. What is it?

A little number problem from H. W. Hardy:

JA4 What number ending with the digit 2 is such that when the last digit becomes the first, the resulting number is exactly twice the original?

Finally, a geometry problem from Mary Lindenberg:

JA5 Given right triangle ABC with coplanar circles constructed on each of its three sides. The center of each circle is on the midpoint of a side of the triangle, and the length of a radius of a circle is equal to half the length of the side of the triangle. If the area of triangle ABC is 12 ft.^{2}, what is the combined area of the smaller circular regions which are not intersected by the largest circular region (the shaded regions in the diagram)?



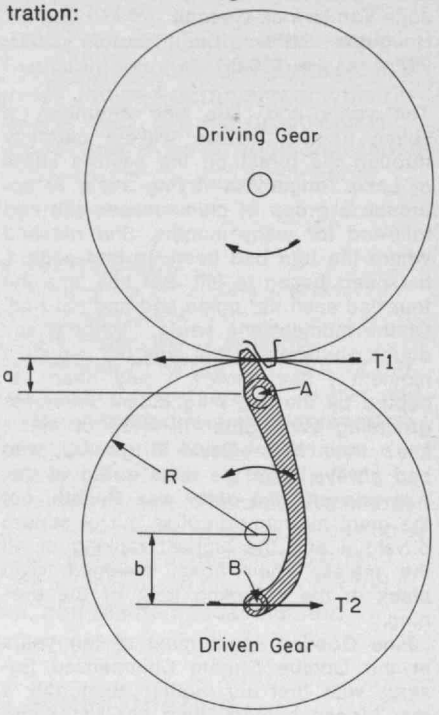
Speed Department

A paradox from Norman Brenner:

SD1 Define $\propto$ to be the complex angle for which tan $\propto$ = i. Then, for any θ, tan ($\propto + \theta$) = (tan $\propto$ + tan θ)/(1 − tan $\propto$ tan θ) = (i + tan θ)/(1 − i tan θ) = i = tan $\propto$. How it this possible?

Here is one from T. Davidson; who writes that someone tried to sell his firm the issued patent for a gear set to produce increased torque in the driven gear at the same r.p.m. as the driving gear. (He does not have the patent number nor the inventor's name.):

SD2 Given the arrangement in the illustration:



Both gears are the same diameter. The driving gear is conventional with teeth cut in the rim. The driven gear is a disc with teeth formed by levers supported by pins A and B. As both gears have the same diameter, input and output speeds will be equal. The driven gear will have the same tangential load (T1) as a conventional gear, but output torque will be increased by reaction of the lever on pin B producing an additional output torque (b · T2).

Solutions

The following are solutions to problems published in "Puzzle Corner" for July/August, 1972:

Jy1 Given these hands:

	♠ K Q J 10 ♥ A K x x ♦ x x ♣ A x x	
♠ 9 8 ♥ Q x x x ♦ J x x x ♣ x x x		♠ A 7 6 ♥ J x x ♦ Q x x ♣ J x x x
	♠ 5 4 3 2 ♥ x x ♦ A K x x ♣ K Q x	

West leads ♠ 9; East takes the first trick with the ♠ A and returns the ♠ 7. Can South make his contract of six spades?

George J. Todd proposes that South can indeed make six spades; here are the 13 tricks he proposes:

1 Lost to East.
2 Taken in dummy.

3 Third round of trumps taken in dummy.
4, 5, 6 Taken by ♣ A, ♣ K and ♣ Q in any order. By now West has had to discard a red card; for the sake of argument, let's say he chose to discard a heart.
7, 8 ♥ A, ♥ K taken in dummy.
9 Small heart ruffed in closed hand.
10, 11 ♦ A, ♦ K taken in closed hand.
12 Small diamond ruffed in dummy.
13 Fourth heart in dummy is now good for twelfth trick.
If West had discarded a diamond on tricks 3 or 6, merely interchange hearts and diamonds in tricks 7 through 13.

Also solved by Burt S. Barrow, Winslow Hartford, Walter Hausz, Jim Kemphner, Bryan Lewis, Thomas Mauthner, John Meader, Dave Mohr, James Poynter, R. Robinson Rowe, Les Serve, Harry Terkanian, Smith D. Turner, and the proposer, Michael Kay.

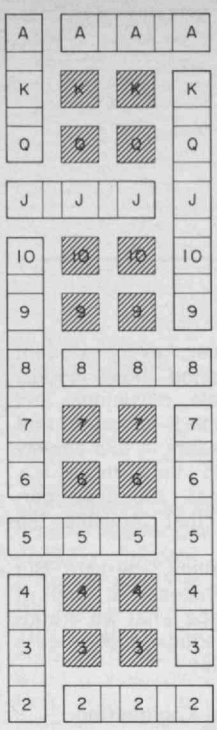
Jy2 Let p be a prime. Can p^2 divide $2^n - 1$ when p does not divide n?

This solution is from Tom Glennon:
Suppose p is a prime ∋ $p^2 \mid (2^n - 1)$; since $2^{\phi(p^2)} \equiv 1 \bmod p^2$, we have
$p^2 \mid 2^{p(p-1)} - 1$. Hence
$p^2 \mid \gcd(2^n - 1, 2^{p(p-1)} - 1)$. But
$\gcd(2^n - 1, 2^{p(p-1)} - 1) = 2^{\gcd[n,p(p-1)]} - 1$, so that if $p \nmid m$, then $p^2 \mid 2^{\gcd[n,(p-1)]} - 1 \Rightarrow p^2 \mid 2^{(p-1)} - 1$. Thus the original problem is equivalent to finding those primes p ∋ $p^2 \mid 2^{(p-1)} - 1$. Of course it is always the case that $p \mid 2^{(p-1)} - 1$, $p \neq 2$.
The square of a prime p ∋ $p^2 \mid (2^{(p-1)} - 1)$ is called a Wieferich square after A. Wieferich, who proved the following theorem in 1909:
If $p^2 \nmid 2^{(p-1)} - 1$, p prime, then the equation
$a^p + b^p = c^p$ has no solution in integers not divisible by p.
It has not been proven that there are infinitely many Wieferich squares, nor has it been proven that there are infinitely many primes p ∋ $p^2 \nmid 2^{(p-1)} - 1$. In fact, there are only two primes < 100,000 whose squares are Wieferich squares; these are p = 1,093 and p = 3,511. As a side note, the Wieferich squares form a subclass of another rare class of numbers called the composite fermatians. These are the composite numbers N ∋ $N \mid 2^{(N-1)} - 1$. There are only 2,043 composite fermatians < 10^8.

Also solved by Gerald Blum, Raymond Gaillard, Judith Longyear, and R. Robinson Rowe.

Jy3 Arrange a full deck of cards in any mixture of groups of three or more by kind or by consecutive sequence of the same suit (example: four hearts, four spades, and four diamonds; or eight spades, nine spades, and 10 spades). What is the maximum number of cards that can be left out such that they cannot be formed into groups of sequences nor added to those previously made?

This solution is from Edward Gaillard:
The maximum number of excluded cards is 16, as the drawing shows:



In order *not* to be able to be added to another group of cards, each card excluded can have at most one card to the right or left which is not part of a previously picked *horizontal* group and at most one card above or below it which is not part of a previously picked *vertical* group. These excluded cards are the shaded cards. I solved this problem by laying out the cards as shown. Since I am only 11 years old, I asked my father to make the drawing for me.

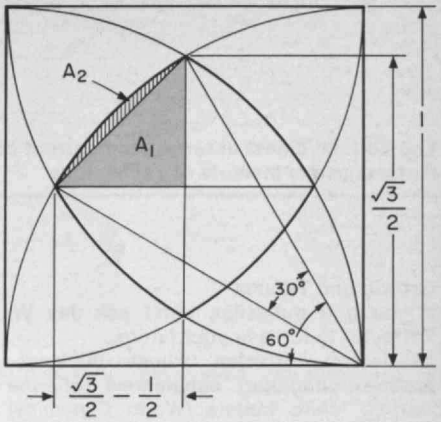
Also solved by Gerald Blum, David Mohr, and the proposer, David Merfeld.

Jy4 Seven thieves stole some gold bars. Unfortunately, when they started to divide the take it didn't come out even. But finally they figured out how to divide the bars: the first thief received one plus one-seventh of the remaining, the second man two plus two-sevenths, etc., the last man receiving seven plus seven-sevenths—i.e., all the remaining bars. In this way they didn't have to divide any bars. What is the smallest number of bars they could have stolen? And which man received the most?

This solution was submitted by Gerald Blum:
Let A be the first man, B the second, . . . and G the seventh. Using the fact that G takes all that's left at that point, we see F = 6 + 6G, E = 5 + 5/2(F + G), etc., yielding after much algebra
F = 6 + 6G, E = 20 + (35/2)G, D = 116/3 + (98/3)G, C = 103/2 + 343/8)G, B = 727/15 + (2401/60)G, and A = 5119/180 + (16807/720)G. This implies G ≡ 2(mod 3), G ≡ 4(mod 8), G/4 ≡ 8(mod 15), G/4 ≡ 23(mod 180); the smallest satisfactory G = 92, giving F = 558, E = 1630, D = 3044, C = 3996, B = 3730, and A = 2176—a total of 15226. Clearly C, the third man, gets the most and G gets gypped!

Also solved by John Bobbitt, Charles Faulders, Winslow Hartford, Karl Kadzielski, Dave Mohr, J. Ralbrancha, R. Robinson Rowe, John Rule, Joel Schwimmer, George Todd, Richard Wobus, and Harry Zaremba.

Jy5 Given a unit square with unit radius arcs drawn centered at each corner, find the exact area of the four-sided (shaded) space bounded by the arcs below:



This solution is from M. Sacid Ozker, who uses A to designate the area required:
$A/4 = A_1 + A_2$
$A_1 = (1/2)(\sqrt{3}/2 - 1/2)^2 = (1/8)(4 - 2\sqrt{3})$
$A_2 = (1/2)(30°n/180°) - \sin 30°$
$A_2 = (1/2)(n/6 - 1/2) = (1/4)[(n/3) - 1]$
Therefore
$A/4 = 1 - \sqrt{3} + n/3 = 1 - 1.7321 + 1.0472 = 0.3151$.

Also solved by Robert Anthonyson, Gerald Blum, Charles Faulders, Arthur Flexser, Raymond Gaillard, Winslow Hartford, Walter Hausz, Joseph Horton, Andrew Kazdin, G. Harold Klein, Mary Lindenberg, Samuel Loebl, Dave Mohr, J. F. Parsons, Robert Pogoff, John Prussing, Claude Rabache, J. Ralbrancha, R. Robinson Rowe, John Rule, David Sales, Donald Savage, Les Servi, W. M. Stephenson, Jr., George Todd, Brian Witzke, Harry Zaremba, and the proposer, Charles Landau.

Speed Department Solutions

Solutions to the "speed" problems given above, as supplied by their proposers:

SD1 $\propto = -\infty$.

SD2 From the following table:

Load:
T2 T1[a/(R − a + b)]
TA T1[(R + b)/(R − a + b)]
Torque:
T1[ab/(R − a + b)]
T1[(R + b)(R − a)/(R − a + b)]

The last expression can be written
$T1(R^2 - Ra + Rb - ab)/(R - a + b)$
and the total torque becomes T1 · R.

Allan J. Gottlieb teaches mathematics at North Adams State College; send solutions and new problems to him at the Department of Mathematics, North Adams State College, North Adams, Mass. 01247.

An Institute Informant

The Editors' digest of recent and current concerns at the Massachusetts Institute of Technology

Growth and Trauma

If you're a publisher, don't ask Jay W. Forrester to foresee your future.

Professor Forrester, whose book reporting computer simulations of the world's future trauma (*World Dynamics*) has brought him wide attention, admits he was "caught off guard." With 40 pages of formulas and 36 computer runs and "generally depressing conclusions," it was not a book "calculated to be popular."

When it came time to publish *Limits to Growth* by Professor Forrester's students Dennis and Donella Meadows, Jorgen Randers, and William Behrens, the error repeated itself. The theme, thought Professor Forrester, was surely "worn out." Not so; that little book—a more popular statement of the method and findings first reported in *World Dynamics*—is now in 12 languages, and the Dutch edition alone is approaching 200,000 copies.

Professor Forrester's conclusion is that he and his associates have indeed found a subtle, almost transcendental thread in modern America: pollution, resource scarcity and crowding—the last perhaps most of all—are beginning to "bear down on the growth process in the world, to generate social pressures which will be expressed in such forms of psychological trauma as crime and drug abuse . . ."

. . . and in sales of *Limits to Growth*.

". . . Our Power Over Our Destiny"

What does M.I.T.'s movement into the arts—dramatic, and, to many, unexplained—have to do with the sciences? Everything, said Archibald MacLeish, at the first annual meeting of the Council for the Arts at M.I.T. this fall.

And then another question, not at all rhetorical: What is to be done about the increasing passivity with which the American people accept the way their government behaves, and the events by which they are surrounded?

It is an unavoidable issue, he said, perhaps the central question for our land and time. And it can be answered here and now:

Even if we assume that the arts are subjective and inexact, the sciences objective and true, we must know that development of the arts here will enrich education in science. How? By helping its students see their proper role, helping them "change the nation's fatalism about our power over our destiny."

For some moments President Jerome B. Wiesner, deeply moved, was silent. This was his view too, he said. No human being can acquire "this kind of understanding" easily—certainly not through an introductory course which teaches only the languages of the arts.

No, said Dr. Wiesner, every student should "have in his mind those models of the world that poets, musicians, and writers have. . . . I think it important that people who will be leaders in this society have an exposure to the private experiences and emotions, the deep personal soul-searching, that motivate the artist."

We need a "dual literacy," he said. But now we all share, instead, a kind of "psychic inability to face what we are involved in. . . . Can the educational process be changed fast enough?"

The Future of Electrical Engineering

Though no one has officially announced even the groundbreaking, a major new building for the Department of Electrical Engineering now looms on the M.I.T. campus, and the Department is beginning its celebration: a series of monthly colloquia on the present and future of many of the varied activities which now fall into the hopper called "electrical engineering."

The following speakers and (where indicated) topics have been identified:

☐ Bernard M. Oliver, Vice President—Research and Development for Hewlett-Packard Co., on "The Quest for Extraterrestrial Intelligence" on January 11.

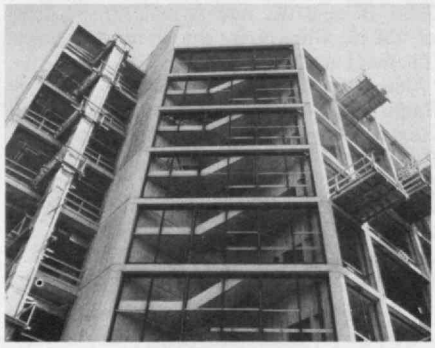
☐ Marvin L. Minsky, Professor of Electrical Engineering and Co-Director of the Artificial Intelligence Laboratory at M.I.T., on February 12.

☐ K. Teer of the Philips Research Laboratories, Eindhoven, Netherlands, on "Information in 1984" on March 15.

☐ Robert N. Royce, President of Intel Corp., on April 12.

☐ Representative Mike McCormack (D—Wash.), on May 15.

Time and place for all lectures: 8 p.m. in Room 9-150—the Center for Advanced Engineering Studies.



To celebrate the approaching completion of its new home (above), the M.I.T. Electrical Engineering Department will sponsor a seminar series on that field's present and future.

Successful, Mobile Managers

Very preliminary results, from a survey of its alumni on the 20th anniversary of M.I.T.'s Sloan School of Management:

☐ 57 per cent of those over 40 are presidents or general managers—if president, probably of a small company (less than 500 employees) that he created.

☐ Final career success is not influenced by baccalaureate background: students who studied science or engineering have no more (and no less) successful careers than those who studied liberal arts before coming to the Sloan School.

☐ Pre-Sloan-School business experience makes no difference in eventual career success.

☐ Half of those over 40 have switched companies at least three times since leaving the Sloan School. "Turnover is a primary characteristic of these people," says Edgar H. Schein, Professor of Organizational Psychology and Management. (His results are based on the first 400 returns from 1,400 alumni—still a low return percentage; hence caution is advised in interpreting the results.)

Tuition Increases

Effective in the summer of 1973, M.I.T. tuition will advance another $200—to $3,100 for the two terms of an academic year. President Jerome B. Wiesner told students that "the combination of austerity and new sources of income cannot prevent continuing tuition increases as costs rise nationally." The goal, he said, is to hold steady the share of total educational costs which students pay as tuition.

A corollary to the tuition increase is a new student loan repayment schedule. Beginning nine months after graduation, indebted students will pay 6 per cent of the estimated median income for graduates in their class and degree each year; as a class moves further beyond graduation, its repayment rate will increase as its earning power increases.

M.I.T. on National Television

M.I.T. is the principal film location for a series of documentaries, "What About Tomorrow?"—the effects of science and technology on our daily lives—to appear in the first half of 1973 on ABC-TV.

The first of the series, dealing with human communication with emphasis on mankind's changing relation to the machines of technology, is to be broadcast nationally on Monday, January 22, at 10:30 p.m. (E.S.T.).

Though M.I.T. is collaborating with ABC News in the series, the intent of both is to use the Institute as a locale and source of information but not as the principal subject. President Jerome B. Wiesner says the Institute hopes only that the project "will help the public understand more clearly the critical role of science and technology in human affairs."

"What About Tomorrow?"
ABC-TV, January 22, 10:30 p.m. (E.S.T.)

Institute Review

An Overstuffed Docket for the Educational Decisionmakers

I'll never get anyone to fill the openings on your committee, moaned Professor William T. Martin to Professor Hartley Rogers at an October 18 faculty meeting.

Professor Martin is Chairman of the Nominations Committee, which fills vacancies on other faculty committees. Professor Rogers, as Chairman of the Faculty, is also Chairman of the Committee on Educational Policy.

Professor Martin's complaint came after Professor Rogers had spent the better part of an hour telling the faculty what the C.E.P. ought to do this year.

By some malign coincidence, virtually every educational experiment at the Institute comes up for evaluation this year. Their merits must be debated, and the faculty must vote to continue them if they show "enduring value."

The Committee's recommendations may well affect the character of undergraduate education at M.I.T. for at least the next half decade, perhaps much longer.

Among issues and programs up for discussion are these:

☐ *The Independent Activities Period.* Two years ago, the faculty voted to end the first term before Christmas and begin the second in February, creating a month in which—theoretically without academic pressure—students could pursue their own interests or take "mini-courses." Last year, over 625 possibilities were advertised in a tabloid "I.A.P. Guide"; many were over-subscribed and less than ten per cent were cancelled for lack of interest. A majority of students stayed on campus.

Yet some still embraced the M.I.T. grind: during I.A.P. students were allowed to earn a maximum of six units (most science courses during the regular academic year carry 12 units of credit per semester) for work done during I.A.P. Others found the compression of the first term troublesome and used the I.A.P. to work off first-term Incompletes.

This year's I.A.P. is the last under the three-time experiment; if it is to be continued, the faculty must approve it.

☐ *Freshman pass/fail grading.* Pass/fail grading was instituted in 1968 as a four-year experiment; it was renewed for one more year by the faculty in 1972, making reconsideration necessary again this year. In last year's discussion most faculty seemed to feel that the pass/fail grading did indeed take the pressure off entering students and did not compromise the ability of freshmen to move onward to more advanced, graded courses in their upperclass years. A scandal of sorts developed during last year's debate when it was revealed that students who took courses to enhance their attractiveness to medical schools were in fact quietly being graded. Prospective medical students and their instructors felt that even in freshman-year subjects, the medical schools would look disdainfully upon students whose records showed merely passes. Some faculty and students were angered that fear and the medical schools should thus impose their will upon an educational experiment at M.I.T. In the wake of this, pass/fail for freshmen was approved for one year, and debate in the faculty must resume this year.

☐ *The Wellesley-M.I.T. exchange program.* This plan, under which students from one school may take without charge subjects at the other, was approved in 1968 for a period of five years. If the exchange is to continue, it must be reapproved this year by both faculties.

☐ *The Domestic "Junior-Year-Away" program.* This plan permits a student to spend this third academic year at another school, if his department agrees that he can obtain benefits there that could not be realized at either M.I.T. or the schools with which cross-registration opportunities exist, notably Harvard and Wellesley. It was approved in 1970 for three years, making this year the last.

Concourse, E.S.G., and U.S.S.P.

Three broad alternatives to the conventional first-year programs at M.I.T. are now available for a limited number of freshmen. This year, all three must be evaluated, and approved by the faculty if they are to continue with a status other than "experimental." Briefly described, here are the three:

☐ *Concourse* "has as its central focus an exploration of the unity and clash of humanistic and technical viewpoints and ideas." It means to create a "teaching and learning community" with eight to ten faculty members and 35 to 50 students, based in the penthouse atop the Sloan Metals Building, which contains a meeting room, a kitchen, a library, and a photographic darkroom. The faculty come from many departments and laboratories. Concourse is structured around general meetings, several times a week, which "take a theme or problem that embraces scientific, technical, and humane aspects and treat it in as great variety and depth as time permits"; and working groups which undertake group-defined problems, then share their results with the community. Satisfactory completion of this "genuinely integrated and extensive educational experience" meets the academic requirements normally fulfilled during the freshman year.

☐ *Experimental Study Group* "is a place where you are given the opportunity to learn what you really want to do, to learn how to learn more effectively, to study as deeply as you want to, and to participate in the life of a small community within the M.I.T. community." E.S.G. suggests that they can best explain themselves by differentiation from the other programs: E.S.G. is not developing new curricula or teaching materials, emphasizing project work, providing extensive laboratory facilities, or presenting a single integrated program of study.

Freshmen in E.S.G. study some subjects in regular M.I.T. classes, receiving credit in the normal way for these courses. Other subjects are developed within E.S.G., and for these students receive unspecified units to bring their total up to the average for the freshman year. Many methods of learning have been tried: concentrated and self-paced study, group meetings, research, one-to-one work with a faculty member, as well as the traditional books and lectures. As the work proceeds, each student works out "with a staff member the way he wants to demonstrate what he has learned about [a] subject."

☐ *The Unified Science Study Program* in the Education Research Center began three years ago, proposing to provide a place in which each student, with faculty help, could plan his own academic program, adding projects, seminars, and self-paced learning to traditional courses. Now that M.I.T. has broadened the opportunities for project work and seminars for freshmen, says the E.R.C., "this type of program is no longer the distinct alternative it once was."

Accordingly, E.R.C. this year offers *A Freshman Project Year* focussing on a single topic: "Buildings and Communities." Each student will satisfy the mathematics requirement by self-paced study

and the humanities requirement by special seminars germane to the Project Year. This fall's program began with an intensive planning seminar occupying the first three weeks of the term, after which an equal amount of time was spent outside the Institute gaining work experience. There followed one month of intensive study to satisfy a freshman science requirement: physics or chemistry. The first term ended with the writing of a proposal for a project to occupy the second semester. That project in the spring will be of such a nature that one or both of the remaining science requirements will be met; if only one, the other will be satisfied concurrently by intensive study.

Et Alia

The overample docket of the C.E.P. does not end with debate over virtually every educational experiment currently underway. Also included in the matters the C.E.P. ought to consider, according to its Chairman, will be:

☐ Issues of the sort raised by a Task Force on Education, that continued the efforts of the Commission on M.I.T. Education. These include increased involvement of undergraduates in research and the creation of an Undergraduate Division under a Dean of Undergraduate Education.

☐ The advisory system: Is student counseling effective enough as it is now done? This will require discussion of three sorts of counselling: that given to freshmen, that given by the departments to their majors, and that of a preprofessional nature—at present mostly in medicine and law.

☐ Interdepartmental efforts in both teaching and research. Professor Rogers offered the Health Science and Technology Program with Harvard and a proposed Energy Laboratory as examples of interdisciplinary areas where the Committee's help may be needed to assure educational effectiveness.

☐ "Political" matters: faculty committees, and whether they serve the needs of the faculty; faculty meetings, and whether they serve them; communication throughout the community, and to the public; the disciplinary process, a subject of debate whenever that committee acts on cases of student protest, as it is currently doing in the matter of the R.O.T.C. takeover of last spring.

☐ Improving the summer program; beyond that, the question of year-round operation, or otherwise changing the academic calendar.

☐ Cross-registration problems: In the light of programs that allow M.I.T. students to undertake a substantial portion of their studies elsewhere, what should a degree from M.I.T. signify?

Two Fraternities Are Coming Home; Will More Follow?

Construction work has begun on an on-campus building that will house two fraternities. Its financing includes a $1.1 million long-term, low-interest loan that commits to the project virtually all the remaining resources of the Independent Residence Development Fund of the M.I.T. Alumni Fund.

This is the north (main) entrance of the new building which will be shared by Alpha Tau Omega and Kappa Sigma fraternities. The other side will face Memorial Drive and the Charles River; Burton-Connor House is at the right of this architect's rendering. Construction is under way, with occupancy planned for September, 1973.

The project is an augury of the future of the fraternity system at M.I.T. Here is its history:

Seven years ago, the office of the Dean of Student Affairs began talks with the alumni and undergraduate leadership of all the fraternities, seeking to review their fiscal strengths and weaknesses and the condition of their buildings. Categories were generated: fraternities whose buildings were in decent shape, those whose buildings were not. The Dean encouraged those with serious problems to discuss them together.

Thus alumni and undergraduates from six houses met with James Eacker, '55, then Administrative Officer in Mechanical Engineering, who had been a member of Alpha Tau Omega. The six houses were Alpha Tau Omega, Phi Sigma Kappa, Kappa Sigma, Sigma Alpha Epsilon, Phi Mu Delta, and Sigma Nu. The first five were located in the Back Bay, the last in Brookline.

Phi Mud dropped out early. The remaining five spent two years formulating their plans. Eventually, Harvey Ellenzweig, a Cambridge architect, was retained by the five.

By June, 1970, the houses knew that they wanted long-term, low-interest financing from M.I.T. and that they wanted to build in Cambridge on M.I.T. property. Their envisaged facility, a complex for the five houses, would have centralized parking, cooking, and recreation areas. M.I.T. offered a site, currently occupied by a warehouse, on Vassar Street, behind the athletic field. M.I.T. would retain the land, and the houses would pay to M.I.T. a rent equal to the property taxes which M.I.T. would pay the city of Cambridge.

At this point, Sigma Nu had dropped out. Their home in Brookline was situated upon land valued at perhaps $40,000; the other four houses, located in Boston, assumed that they could sell their land for more than $100,000 each. Further, they owned their land, while Sigma Nu still carried some debt.

The remaining four houses would have to commit $40,000 for detailed architectural plans. That hurdle was too much, and two more dropped out P.S.K. decided that it liked its Boston surroundings. S.A.E. apparently experienced a typical difficulty: those who approve and undertake a massive improvement in their college environment will not be the ones who benefit from it. A few members were intensely interested in the project, but they seemed to be architecture majors.

Two fraternities then remained: Alpha Tau Omega and Kappa Sigma. The Vassar Street site now made no sense. But a parking lot on Memorial Drive between Burton House and Delta Kappa Epsilon fraternity was offered and accepted. A new building design, commissioned also of Ellenzweig, was presented to M.I.T. last March; since then a few minor changes have been made, a zoning variance sought and approved, and parking spaces to satisfy city regulations found elsewhere at the Institute.

The financing scheme provides a long-term, low-interest loan from the Independent Residence Development Fund, established eight years ago as part of

the M.I.T. Alumni Fund. The I.R.D.F. had $300,000 of its funds tied up in renovations in the independent residence system. By providing a 40-year loan at three per cent interest, I.R.D.F. commits virtually all its remaining resources—$1.1 million dollars—to this project. (Contributions to the Fund, though, have averaged over $100,000 a year, so the Fund will soon have funds to work with once again.) Sale of the two fraternities' existing buildings and land will raise enough additional money to meet the $1.4 million overall cost of the project.

Though they will be in a single five-story building, the two fraternities will be connected only by one common stairwell that meets building regulations for entrance and egress at a savings in cost. Dining, recreation, and kitchens will be separate; it was found that combining them, useful for a complex of five fraternities, would serve no financial purpose here. Each fraternity will house about 45, mostly in single rooms. The view will be of the Charles River or Briggs Field.

Construction time is estimated at 44 weeks; with construction started at the end of November, the building with luck will be ready for occupancy for the fall term next year.

House bills are expected to run about $185 a month, compared with about $150 now. Fraternities have in the past tried to keep their prices competitive with those of the dormitories, though fraternities provided more services—or at least a greater number of meals—than did dormitories; $185 a month is not seen as very different from the cost of living elsewhere in the area.

Richard Sorenson, Associate Dean for Student Affairs, believes at least five or six M.I.T. fraternities ought to look seriously at this idea. These are fraternities whose houses are deteriorating and may presently need extensive repairs, which may be impossible in parts of the Back Bay where zoning regulations make fraternities a "non-conforming" use. He predicts that in 15 or 20 years, as much as a third of the fraternity system of 29 houses might make the move back to M.I.T. land. Though it appears that riverfront property will serve the dormitory system in the future, there is land behind the athletic field that might be available to the fraternities, should they choose to come home.

Hungry but Flourishing . . .

. . . was the appraisal of his domain by Irwin W. Sizer, Dean of the Graduate School, at a faculty meeting on November 15.

For the first time, Dean Sizer reported, M.I.T. is the first choice of students seeking Ph.D.'s who receive National Science Foundation fellowships—14 per cent of the 1972 winners came to the Institute. And this year, M.I.T.'s graduate student enrollment rose three per cent to 3,328—though a decrease had been forecast.

But Dean Sizer contrasted the situation at M.I.T. with that in graduate education nationwide: Enrollment at the so-called "top 20" U.S. graduate institutions declined by 12 per cent from last year to this. But enrollment at other schools—notably state-supported institutions—increased enough to offset this downward trend, so that total enrollment in U.S. graduate schools has increased by 2 per cent.

To Dean Sizer, the figures are evidence that "the typical graduate student does not like to borrow money. Rather than borrowing money, he will go to another institution where the living is easier. . . . There are dire predictions that the quality of graduate education may go down in the United States if this trend continues."

Dean Sizer provided additional support for his choice of adjectives to describe M.I.T.'s Graduate School:

☐ Flourishing: The philosophy of graduate education at M.I.T. is changing, says the Dean. M.I.T. is moving "away from high degree of specialization even at the Ph.D. level." Students discover that "they need breadth as well." This need for breadth has come about through interest in interdisciplinary societal problems. As a result, the graduate school has established or is establishing degree-granting programs in oceanography, biomedical engineering, urban studies, materials engineering, and environmental engineering (approved by the Committee on Graduate School Policy the day before the November 15 faculty meeting). In the future, suggested Dean Sizer: artificial intelligence and science education, among others.

☐ But hungry: Four years ago, about 700 graduate students at M.I.T. were supported by federal fellowships. About 300 M.I.T. graduate students are supported in that way now, and Dean Sizer fears the number may shrink as low as 200. The 400 drop in four years represents $2.4 million "which has, as it were, gone down the drain." This problem was foreseen some two years ago, and M.I.T. resources were used to establish about 90 Sloan Basic Research Traineeships, though "we had to rob Peter to pay Paul": the money would have supported faculty and bought equipment. Private foundations and the National Science Foundation have increased their support, though modestly.

All this does not come close to making up for that drop of 400, yet enrollment is holding up. Dean Sizer suspects that more students than before are somehow supporting themselves; but exactly how cannot be known until the students are asked, and this study is in progress.

☐ Dean Sizer guesses that the expenses—living and educational—for a graduate student total about $8,000 yearly. "The thought of borrowing this from a bank is unrealistic." So is any notion that fellowships, scholarships, and loans can provide this kind of help for all M.I.T. graduate students in the future, though we ought to "go out and beat the bushes." Dean Sizer thinks that increasing the number of research assistantships is the answer; he hopes that each faculty member can eventually gain enough financial support for his research so that one graduate student each could be fully supported.

This year, the number of M.I.T. research assistantships has grown from 1,521 to 1,552. "Maybe that's pretty modest progress," said the Dean, but it means that "one way or another, we are trying to keep the show going."

Why They Didn't Come, and Why They Did

The M.I.T. Graduate School for the first time queried students this summer who had been admitted to the Institute but elected instead to go elsewhere. (Of 437 such students, 77 said they went instead to Harvard, the largest competitor; 46 went to Stanford, 34 to Princeton, 29 to the University of California (Berkeley), and 22 each to Cornell and California Institute of Technology.)

Analyzing responses, Sanborn C. Brown, Ph.D.'44, Associate Dean, concluded that "the nature of financial assistance" was the reason most-often cited by students who did not accept M.I.T.'s graduate admission; next in line—and a close second—came "general location, environment, and climate." The latter was the most frequent complaint of applicants to the Schools of Engineering and Science, the former the decisive factor for applicants to the Schools of Management and of Humanities.

But there is some ambivalence here. The primary reason for coming to M.I.T. cited by those who registered here this fall was "the quality of academic and research offerings." But next in line were "approval of the general location, environment and climate"; and third in the list was "the nature of financial assistance." Only 14 out of some 400 new graduate students reported on Registration Day that they were "seriously worried about the cost of living."

Guilty of R.O.T.C. Trespass

Court action has now ended for 19 persons found guilty in the Third District Court of Middlesex County during the summer in connection with the occupation of the R.O.T.C. offices at M.I.T. in May, 1972 (*see* Technology Review *for June, 1972, pp. 74-76, and October/November, p. 80*).

All 19, having been found guilty, had appealed for new trials in Superior Court. Before the Superior Court in Lowell, Mass., last fall, all 19 entered pleas of guilty. The Court's decision was to set aside the jail sentence of one defendent, imposing a $100 fine. Two others originally receiving 30-day sentences were instead given suspended sentences, placed on six months' probation, and fined $100 each. The Superior Court reduced the fines in the remaining cases from $100 to $50.

It's Clear That the School as a Whole Won't Find Limits to Growth in Its Role

Forgive us, but we did not compose that doggerel.

President Jerome B. Wiesner took credit for those lines, which he added on to some other poesy purportedly supplied by a "Vice President for Limericks" for the banquet celebrating the 20th anniversary of the Sloan School of Management on October 27.

It was a festive—if not immensely animated—occasion for nearly 400 gradu-

ates, faculty, students, and their guests. The Sloan School is a leader, thought W. Van Alan Clark, Jr., S.M.'42, Chairman of Sippican Corp., when judged by the standards of the late Professor Erwin H. Schell, '12: "The way to tell a leader is if he has followers."

Another of Mr. Clark's reminiscences had to do with E. P. Brooks, '17, who came to M.I.T. in 1952 as the first Dean of the (then) School of Industrial Management after a long career at Sears, Roebuck and Co.: "At Sears, when you say 'jump' to someone he jumps. But all a Dean has working for him is a faculty."

Presented with a scroll and standing ovation, Mr. Brooks quipped that "old deans don't disappear—they just lose their faculties."

Closer Links with Society

There were more serious moments. Discussing its problems and opportunities, William F. Pounds, present Dean of the Sloan School of Management, noted that its position is "capital-poor. We suffer from a low price structure," with the result that "at the moment we're allocating losses, not resources."

But this is not necessarily a source of weakness—just a way of life familiar to the School since its founding. Its strategy is the same now as then: diversity—in faculty, students, programs and service. Its goal is to prepare students to deal with "complex issues wherever they arise," in private industry or public service, in line or staff. But it's also important to recognize what cannot be done, said Dean Pounds. "Boldness, character, and sense of timing" are important attributes of the manager, he said, but they are not subjects for the classroom—rather for "the environment in which learning is provided."

What of the future? Some changes, thinks Dean Pounds:

☐ The School's small-project style of research has been productive—and will continue to be. But today's problems tend to be larger, and for productive work on some of them broader participation will be required. For examples: health care delivery systems, incorporation with the Joint Harvard-M.I.T. Program in Health Sciences and Technology; energy resources and energy conservation; transportation; technology transfer and assessment; productivity. "In each of these there is a broad component of management," said Dean Pounds. "I see a closer linkage with other schools at M.I.T. and with current problems of society as an important opportunity."

☐ Education for managers at mid-career is perhaps the "biggest opportunity" in the education industry, he thinks. But it also offers some sticky problems: "How to organize the market? How to deliver to it? And what to deliver?" An alumnus in the audience agreed: "Aren't we overtraining young people and undertraining older people?" Another suggested the problem of finding good students: "If they were heading for success they wouldn't be coming back."

☐ More emphasis on accelerated programs—and other ways to increase teaching efficiency. For example, the 12-month master's-degree program, an "exciting educational experiment." Can the faculty really cover the material that way? asked an alumnus. "We surely covered economics," Professor Sidney S. Alexander assured him.

The "Insidious Effect" of Research Imbalance

All in all, a "remarkably successful" school, concluded Dean Pounds.

But there are two problems, aside from its low price structure:

☐ The need for better teaching facilities. "Our classrooms now limit the amount and effectiveness" of a Sloan School education, he said.

☐ Better support for research on problems in the private sector. It's hard to maintain a balance between government and private sponsorship, and this is troubling because "the support for research has a subtle and insidious effect" on the whole educational experience a school can offer.

☐ The situation for financial support of Ph.D. students in the Sloan School is "grim," Dean Peter P. Gil said, when it came time for him to report on educational developments.

☐ And the Sloan Fellowship Program is seeking a more balanced group of students—as to industrial background. The insurance and food industries, for example, are under-represented.

A Sloan School Graduate's Career: From Staff to Line to President

Over one-third of the Sloan School graduates over 40 years old are company presidents.

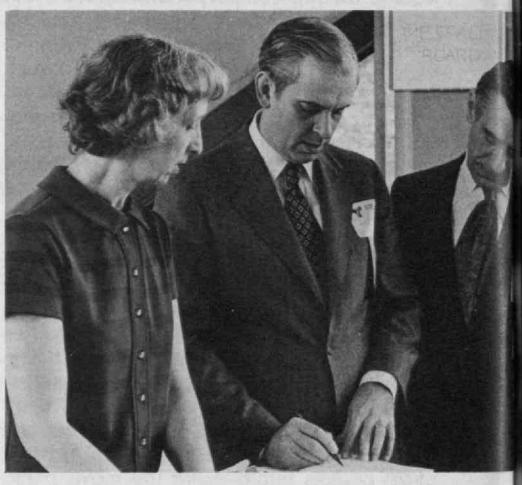
And over one-fifth of the 40-year-old-or-over group have incomes of over $50,000 a year.

Both figures are pushing the data a bit too hard, thinks Edgar H. Schein, Professor of Organizational Psychology and Management in the Sloan School. They come from replies to a questionnaire sent to all 1,400 graduates of the School's Master's-degree program; but so far only 30 per cent of the questionnaires are back, and that's a small sample on which to base any conclusions.

But after giving them that caution, Professor Schein proceeded to give some 300 alumni of the Sloan School of Management, at M.I.T. for the 20th anniversary celebration (*see above*), some preliminary results:

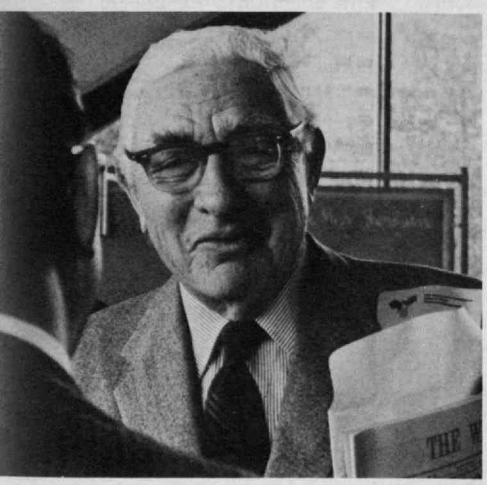
☐ An increasing proportion of recent graduates have entered the Sloan School with M.I.T. undergraduate degrees; but the source of their undergraduate experience—whether M.I.T. or elsewhere—seems to have little to do with the success of alumni following their Sloan School graduation.

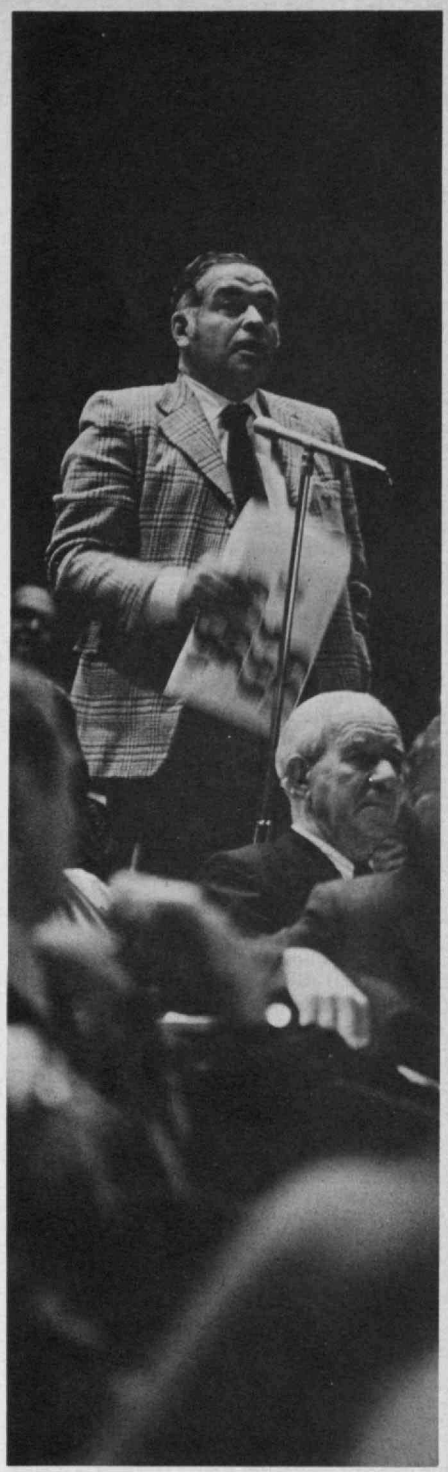
☐ Of alumni over 40, 77 per cent came to the Sloan School having undergraduate degrees in science or engineering; of younger alumni, 69 per cent. The effort to broaden the base of entering students' experience is obviously proceeding slowly, Professor Schein noted; but he can find "no consistent relationship between undergraduate major and later career success."



For 36 hours this fall several hundred alumni of the Sloan School of Management dropped their day-to-day concerns to celebrate their School's 20th anniversary. Reminiscence was the order of the day, and only a few of the pictures require captions:
Above: Miriam Sherburne, Dean William F. Pounds, and Associate Dean Peter P. Gil at the registration table. Top, opposite: the School's three deans—(left to right) E. P. Brooks, '17, Howard W. Johnson (now Chairman of the M.I.T. Corporation), and William F. Pounds.
Center, opposite: "I don't happen to be a 'no-growth' guy," said Richard C. Gerstenberg, Chairman of General Motors, when he reached the platform after a conversation with Mr. Johnson. Bottom right, Walter B. Wriston, Chairman of the First National City Corp., with much the same philosophy: "Clean air is called poverty."
Bottom left, opposite: Randall S. Robinson, '55, Chairman for the event, gave each Sloan School dean a plaque to commemorate the occasion; the picture shows him with Dean Brooks, who spent the two-day celebration basking in old friendships.


Edward Pennell Brooks





☐ Of alumni over 40, 76 per cent came to the Sloan School directly from college; of younger alumni, 88 per cent. There appears to be no correlation between prior business experience (or lack of it) and later career success.

☐ The typical Sloan School graduate progresses from staff to line to top management position: of graduates 30 and under, 46 per cent are now in staff jobs; of those 30 to 40, 39 per cent are in line jobs; of those over 40, 57 per cent are presidents or general managers. More recent graduates are more likely to start their careers in staff jobs, however.

☐ Relative to other M.I.T. alumni (in science, engineering, or architecture, for example), Sloan School graduates "are doing very well indeed"; their salaries are "clearly higher" for equivalent age and experience.

☐ "Turnover is a primary characteristic" of a Sloan School graduate. Only 44 per cent of those 30 and under are in the firms they joined upon graduation, only 30 per cent of those between 30 and 40, and only 11 per cent of those over 40. Half of the 40-and-up group have moved three or more times. "Don't judge a man's career on the basis of the first ten years," said Professor Schein.

☐ Just over three-quarters of the School's graduates are in private industry, 17 per cent in education, 7 per cent in government. And increasing numbers of graduates are going into service industries.

What do alumni think of their Sloan School experience?

No one knowing the great diversity in careers of Sloan School alumni would expect consensus on that question, thinks Professor Schein. Most alumni agree that finance and accounting were valuable parts of the curriculum; next come marketing and organization studies.

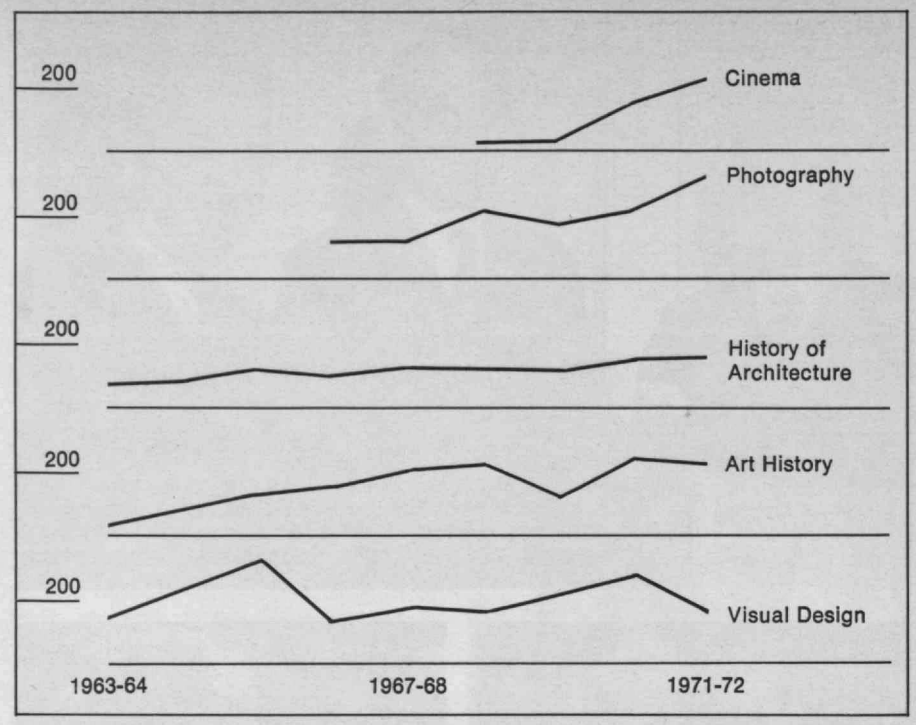
The quantitative and systems-oriented studies—the "hallmark of the School," Professor Schein admitted—are the controversial ones; they were mentioned "either very positively or very negatively, depending on the respondent's present job." The thesis? "Not much mentioned."

On the Way to a Dual Literacy, We Have a Tiger by the Tail . . .

. . . and we need some help holding him down.

The phrase about the dual literacy was President Jerome B. Wiesner's (*see p. 68),* and the phrase about the tiger was from Professor Wayne V. Andersen, Chairman of M.I.T.'s Committee on the Visual Arts and Director of Exhibitions. Both were speaking this fall at the first annual meeting of the Council for the Arts at M.I.T., and two of Professor Andersen's colleagues recorded the same kind of successes that led Professor Andersen to call for help.

Opening the meeting, President Wiesner outlined his view of the role of the arts as curricular and extracurricular experience for M.I.T. students and staff: to enhance our richness in the traditional fields, to "provide a counterpoint for quantitative, rigorous learning by emphasizing human styles—the expressive, creative, skills.



Professor Wayne V. Andersen, who is Chairman of M.I.T.'s Committee on the Visual Arts, believes enrollment in that field suggests "the state of our mind—and of our health." Last year the Department of Architecture—in which most of the courses are given—faced a dilemma: let enrollment continue to grow, or curtail growth so as to maintain quality. The latter was chosen, and this year, Professor Andersen told the Council for the Arts at M.I.T. this fall, it is "harder to get into visual arts courses than to pass calculus."

"The 'two-cultures' dichotomy is too simple," he said. "It is a many-culture problem, complicated by language barriers and lack of a common cognitive style." The result is a language and communication barrier that "prevents individuals from communicating with each other, even prevents one person from communicating with a discipline or an area of human experience or even, I would claim, from communicating with himself about that discipline and, consequently, from being supported by it as he engages in his professional work.

"Simply stated," said Dr. Wiesner, "we want our scientifically-oriented students to know the cultures—the cognitive styles, in my idiom—of the arts."

"They Don't Believe . . ."

Even the fairly superficial question of visibility is "a very serious matter," replied Paul Tishman, '24, the Chairman of the Council for the Arts. The Institute has an undeserved "image of sterility," he said, citing the surprise of many of his friends —"They don't believe!"—when he tells them that Carnegie Hall in New York can be sold out for a concert by the M.I.T. Symphony Orchestra.

Professor Andersen reported his pride: M.I.T. has achieved "unequivocal status as a center in the visual arts," and if there were enough classrooms and studios and teachers "we could enroll more than twice as many students as we now have."

The same problem from Barry B. Spacks, Associate Professor of Literature: a 10-fold increase in six years in the number of students wanting to study fiction and poetry writing. To the crucial question, "What happens to a student as he creates a piece of literature?" Professor Spacks' answer: he experiences "the release of energy which comes with discovering the means of communication."

"Fill Our Spaces with Music . . ."

"One cannot amplify a work of art until he has served it," said John L. Buttrick, Director of Music. He did not mean the electronics of stereos and tapes; he meant the students' real understanding of music and musicians. This year two-thirds of M.I.T. sophomores are taking music, there are so many string players that M.I.T. will develop a whole new string orchestra, and a Pandora's box has been "fearlessly opened" by adding piano to the music curriculum so that students can hear music while they study it.

"We want to fill our spaces with music. . . . They will be making music on parapets, in halls, in lobbies, on the grass . . . "

Beyond this vision of a musical M.I.T., Mr. Buttrick listed three activities through which technology and music may be brought together at the Institute:

☐ The Studio for Experimental Music, where a computer has now been designed "to perform digital sound synthesis in real time"—which means, he explained, that true composition and notation of electronic music becomes possible.

☐ An opera production group, because this form of musical expression "gives so many opportunities for the kinds of things we are good at:—staging, lighting,

visual design, and the spatial relationships of audience, actors, and music.

☐ A project in designing and repairing musical instruments; this is becoming a lost art in the U.S. and we need to know how to create in modern instruments the mellow sound which is associated with old ones.

"The Arts Are a People Thing"

Eric Larrabee, Executive Director of the New York State Council on the Arts, credits the line to Bob Hope, and he used it to apologize to members of the Council on the Arts at M.I.T. this fall (*see above*) for talking so much about organizations and finances.

"What we are trying to talk about," he said, "is something very real and very live and very virile."

His experience in New York State suggests a few problems for the arts at M.I.T.:

☐ "You must get away from diletantism in the arts," he said. Art must be embedded in the ongoing life of the university.

☐ Let the arts match other disciplines by contributing in three ways to university life—through teaching, practice, and research. When any of these elements fail, said Mr. Larrabee, comes "overt guerrilla warfare between scholars and practitioners," for example.

☐ Every artist and student tends with time to change his view of himself from amateur to professional, to cut himself off from the people who need him.

No child—nor any student—"should be denied an experience in art because he never met anyone to show him what he could do." In this sense, said Mr. Larrabee, "the university can be the world that we want in microcosm."

For Art, Poetry, Dance, and Archeological Research . . .

. . . the Council for the Arts at M.I.T. has made grants totalling nearly $10,000.

But that is less than one-tenth of the total of gifts and pledges announced by Paul Tishman, '24, its Chairman, at the first annual meeting of the Council this fall (*see above*). He said the funds, totaling $100,000, were evidence of a "major commitment to a new pace for American education."

The Council will support arts activities of many kinds at M.I.T. Its first grants include $1,250 for a dance workshop, $2,500 to the Student Art Association, which operates studios and teaching activities in the Student Center, $1,500 for a visiting poets series, and $3,730 to support work in the Laboratory for Archeological Research in the Department of Humanities.

Photography on Prayer

Dining Room Three of the Faculty Club contained perhaps fifteen people who were to be fed by the M.I.T. Committee on the Visual Arts on the occasion of the opening of a photographic exhibition entitled "Octave of Prayer" in Hayden Gallery. The exhibition was organized by Minor White, Professor of Photography in the Department of Architecture, who once every two years puts together an exhibition that opens in Hayden and then goes on tour.

Peter Spackman of the M.I.T. News Office was speaking about the relation of the camera to human perception. "Perhaps," Mr. Spackman said, "Minor will begin by saying what that interaction is about."

"I think we should begin by eating," said Professor White.

"Is that the interaction?" asked Professor Wayne Anderson, Professor of Art History, Chairman of the Committee on Visual Arts, and Director of Exhibitions. "Visual nutrition?"

Everyone began to eat. Mr. Spackman, undaunted, asked what the eye behind the camera searches for.

Professor White suggested that the photographer became capable of thinking of himself as a camera. But "search generally means spiritual search, whatever that means to whoever is doing it."

The exhibition is on a spiritual theme. Its title derives from a division of prayer into eight stages, through meditation to mystical union. Being infatuation with image or symbol, photography and writing can only advance through the initial three stages of prayer—petition, affective prayer, meditation—and must be left behind by those who plan to journey farther. But even though confined to those levels, photography can provide an external image of prayer (illusory or authentic, the perceiver must wonder) or aids to attaining those three levels. Photography might further be a base or shelter to those who have begun their striving in that medium. Professor White offers his own experience in a text in the exhibition's catalog: "Photographing after periods of enforced abstinence, I feel as if I have come home."

Professor White teaches a course entitled "Creative Audience." He explains: "The survival quality of art is much less important than the sheer process . . . The moment when it's being made is important . . . so the audience has as much responsibility as the 'artist'." And the only thing that matters is that living beings create: "They can't do it when they're dead, at least as far as we know."

For a moment, no one spoke. The silence was finally broken by Professor White's soft laughter.

Five Grants, for a Total of Just Under $1 Million . . .

. . . have come to M.I.T. this fall to support important new work in as many different fields:

☐ $230,000 from the Rockefeller Foundation for an international program on problems of malnutrition in low-income countries.

☐ $75,000 from the Andrew W. Mellon Foundation to the M.I.T. Press, part of the Foundation's $5 million program of grants to university presses and independent research libraries "to aid scholars and scholarship."

☐ $210,000 from the Department of Housing and Urban Development to the System Dynamics Group in the Sloan School of Management for studying urban dynamics in Lowell.

☐ $400,000 from the Ford Foundation for research and teaching programs in international activities.

☐ $30,000 from the National Science Foundation for a short course for college teachers.

An Alternative to Changing Diets

F. James Levinson, who has just come to M.I.T. from service as Chief of the Nutrition Branch of U.S. A.I.D. in India, will direct the new nutrition program, the goal of which will be to find a better way: most food programs for underdeveloped nations, says Dr. Levinson, have been based either on persuading people to change dietary habits or on bringing aboard medical help. Neither has worked, and Dr. Levinson is now convinced that "a wider interdisciplinary approach is needed."

That approach will be provided at M.I.T.

by the Program's affiliation with the Department of Nutrition and Food Science and with the Center for International Studies, and it will eventually involve other departments at M.I.T. and Harvard.

Dr. Levinson himself brings considerable experience in nutrition planning to the task. He studied at Harvard and Cornell and in addition to nutrition-related work in India he has served as a consultant to the Brookings Institution and the World Bank.

". . . Major Needs in the Area of Scholarship"

Howard R. Webber, Director of the M.I.T. Press, found the Mellon Foundation grant a surprise which "suggests that there are those out in the world who are aware of our problems, (giving) careful attention to what are major needs in the area of scholarship."

In its announcement of $5 million in grants for scholars and scholarship, the Mellon Foundation spoke about the problems "in a period for many institutions of acute financial stringency." Mr. Webber lauded that observation, too: university presses are supposed to be able to publish books whose profit potential is too low to justify commercial publication. But the "break-even" requirements that poverty-striken institutions tend to impose on university presses subvert that purpose.

President Jerome B. Wiesner, who wrote Nathan M. Pusey, President of the Mellon Foundation, described himself as happy with the grant and Mr. Webber "as positively ecstatic."

"Well Intentioned but Short Sighted . . ."

The Department of Housing and Urban Development gave M.I.T. over $200,000 for studies proposed in a graduate thesis by Walter W. Schroeder III, '70: Finding out if the principles developed in *Urban Dynamics,* the computer-simulated urban growth model proposed by Jay W. Forrester, Professor of Management at M.I.T., in fact apply to a single city as well as to an idealized summation of many cities (*see* Technology Review *for October/November, pp. 60-61*).

Lowell was chosen for the test case, says Professor Forrester, because "it seems to exemplify the well-intentioned, but often short-sighted, decisions that cause many urban programs to run aground."

"New International Perspectives . . ."

With a three-year, $400,000 grant, the Ford Foundation has renewed its support of international research and programs in many schools and departments at M.I.T.

Most of the funds will be used in the Center for International Studies, according to Eugene B. Skolnikoff, '49, Head of the Department of Political Science, where the need for unrestricted funds such as this grant is keen; "the need to develop new programs and new perspectives, many of a necessarily experimental nature, is growing within the international field generally," he wrote in a statement.

But the Ford grant will also be used for work in the Departments of Humanities, Civil Engineering, Architecture, and Urban Studies and Planning, and in the Sloan School of Management.

Keller Personalized Instruction

With just under $30,000 provided by the National Science Foundation, the M.I.T. Education Research Center will conduct a two-week short course in using the Keller Personalized System of Instruction next June.

The system, named after Professor Fred Keller of Columbia University, is a plan for personalized instruction on a self-paced basis; the M.I.T. course will be given by Ben A. Green, Jr., of the E.R.C. staff.

Three Good Months for Braillemboss . . .

. . . were climaxed this fall when the computer-based high-speed braille embossing device developed at M.I.T. was one of 20 Massachusetts winners of 1972 *Industrial Research* new products awards.

Earlier, Braillemboss:

☐ Completed translation into braille of its first novel—*In Darkness,* by Roger Bourgeon.

The 182-page French novel—a story about a blind man—was converted into 258 pages of grade II braille; the process involved typing the novel into a teletypewriter (20 hours) connected to the Braillemboss computer, which turned out the book (after proofreading) in nine hours.

☐ Was adopted by the Internal Revenue Service to help blind taxpayer service representatives work on an equal basis with its sighted representatives.

The I.R.S. application of Braillemboss comes about through storage of income tax information and files in computer memory banks. Blind taxpayer service representatives can now obtain braille print-outs of the data they need.

Industrial Research cited Braillemboss for "importance, uniqueness, and usefulness in its field." Braillemboss is basically a system for automatically producing material in braille from English-language input through a computer. Other Industrial Research winners in Massachusetts included ceramic single-crystal fibers (Arthur D. Little, Inc.), a heart pacemaker (American Optical Corp.), disposable foam ear plugs (National Research Corp.), noise dosimeter (General Radio Corp.), and a sphygmometrograph—a device that permits a patient to take his own blood pressure (Sears, Roebuck and Co.). The award to Braillemboss was accepted by Robert W. Mann, '50, Professor of Mechanical Engineering; he was joined by George F. Dalrymple, '56, Acting Director of M.I.T.'s Sensory Aids Evaluation and Development Center.

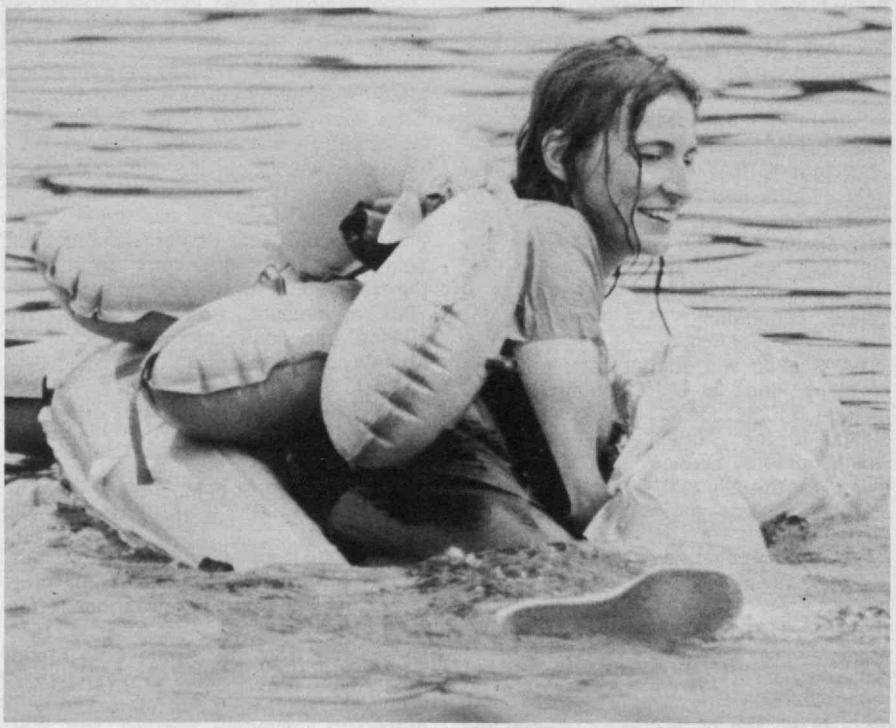
"Some Survival Test!"

Did she like A.F.R.O.T.C. summer camp?

Oh yes, says Elsie Wilson, '74—the experience was "great . . . a cross between Girl Scout camp and a parochial school."

Miss Wilson, whose major is management, was the first M.I.T. coed to attend an R.O.T.C. summer camp; she spent six weeks at Gunter Air Force Base in Montgomery, Ala., doing physical training, marching, pistol and rifle practice, pilot training, and survival lessons. The days began with calisthenics at 5:30 a.m.; then came breakfast, inspection, classes, parades, orientation, target practice, and athletics.

"Sports caused some confusion," Miss



The picture belies Elsie Wilson's ('74) recollection of water survival training at A.F.R.O.T.C. summer camp last summer: "If you've ever gone swimming fully clothed and wearing tennis shoes, you can imagine how ungraceful we looked." (Miss Wilson was the first M.I.T. coed at any R.O.T.C. summer camp.) (Photo: U.S.A.F.)

Wilson told *Tech Talk* this fall. "They didn't know what to do with women. Someone suggested we be cheerleaders, but we quashed that idea. We finally got our way and each team had at least two women." (Miss Wilson's unit included 23 men and six women, about average for units in the camp.)

An overnight survival mission presented no real problems. Miss Wilson's unit was caught by a storm, her tent collapsed, and "we ended up sleeping on a pile of parachutes in the back of a truck. Some survival test!"

The best part of it all was flying. Each student took the controls of a twin-engine T-29 and a T-33 jet trainer, where "we rolled, made dives and sharp climbs, flew upside down, played tag with clouds, and did backward flips."

An Unexplainable Intuitive Leap

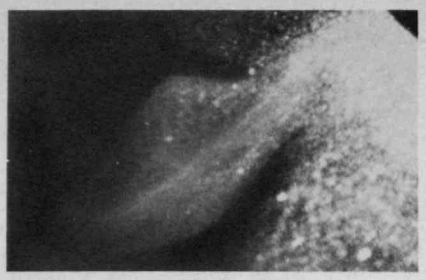
John R. Schrieffer, '53, finished his undergraduate thesis in the M.I.T. Department of Physics in 1953—a paper on theoretical atomic structure under the supervision of John C. Slater, who was then Harry B. Higgins Professor of the Solid State.

By then he had decided on theoretical physics, and he was attracted to the University of Illinois, where Dr. John Bardeen had recently established himself, having already won a reputation as one of the world's outstanding solid-state theorists as a result of work at Bell Telephone Laboratories.

Four years later Dr. Bardeen, Leon N. Cooper (a postdoctoral research fellow drawn to Illinois, like Schrieffer, to work with Dr. Bardeen), and John Schrieffer took what their colleagues now describe as "a brilliant intuitive leap" to produce their theory of superconductivity. They thus solved a riddle to which many theoreticians (including Dr. Bardeen himself) had devoted many years of research and thought.

Just as this breakthrough was taking form, Dr. Bardeen was given his first Nobel Prize (1956) for his part in the work at Bell Telephone Laboratories which resulted in the invention of the transistor. Sixteen years later he became the first man ever to win two Nobel Prizes in the same field. He, Dr. Cooper, and Dr. Schrieffer—who is now the Mary Amanda Wood Professor of Physics at the University of Pennsylvania—shared the 1972 Nobel Prize in Physics for the B.C.S. (so-called, for their initials) theory of superconductivity.

Superconductivity is a phenomenon which defies common sense—and which for more than 50 years after its discovery in 1911 equally defied theoretical explanation. Certain metals and semiconductors simply lose resistance to electrical current flow and become near-perfect conductors at temperatures near 0°K.—absolute zero. The B.C.S. Theory, which for the first time made clear how materials could in fact behave that way, has been described as the most important achievement since the quantum theory in advancing theoretical understanding of the universe. But there is no simple explanation which laymen can grasp.



It was early in August, 1972, that Robert H. Rines, '42, and several associates rigged a "sonar trap" in the Loch Ness. A few days later, on August 8, there was an "event": the sonar record shows "two undulating objects" passing through, and three images were made by underwater strobe cameras provided by Harold E. Edgerton, Sc.D.'31, Institute Professor Emeritus at M.I.T. Two of the images showed nothing; but one, after computer processing to add definition, is the picture above. Mr. Rines is certain it shows the fin of the long-sought Loch Ness monster.

"There Are at Least Two Large Things . . ."

Are there "large marine animals" in Loch Ness, Scotland?

The question is far from original, asked by a good many tourists, stimulated by occasional reports of sightings, and—according to many authorities—improved upon by the psuedo-scientific observations of some enthusiasts.

One of the enthusiasts was back on stage at the Northeast Electronics Research and Engineering Meeting in Boston last fall: Robert H. Rines, '42, insisted on the basis of new evidence from sonar and underwater electronic strobe photography that "large creatures do in fact exist in the lake; and sufficient competent scientific information has now been recorded to enable an international jury of experts to talk of the approximate size, nature and possible identification of these beasts."

The experts, according to Mr. Rines, agree that:

☐ The sonar and underwater photographic evidence is entirely authentic and genuine, and not artifact.

☐ From the sonar evidence, it is clear that there are at least two large marine animals in Loch Ness.

☐ These animals are at least from "20 to 30 feet" long, with an "appendage" of about "10 feet."

☐ Not only are they "large," but "they are moving, and they reappear at different ranges and on different instruments with similar signature" indicating "that the creature has several segments, body sections or projections such as humps."

☐ The simultaneous underwater strobe elapsed-time photographs are at extreme range, and appear to show "flipper" and "tail"-like structures, which photographic and optics experts measure as six to eight "feet in length including the supporting leg" and two to four feet in maximum width.

☐ The texture, while somewhat amorphous, appears rough and the color shown on the film is greenish-brown.

☐ The object, though under study for some weeks, has not yet been identified by zoologists. One report, however, states that the "tail" structure resembles the shape of the tail of newts (lizards).

☐ Smaller underwater life has also been photographed and is under study. The experts' present identification is a "winged invertebrate."

Mr. Rines, who is President of the Academy of Applied Science of Belmont, Mass., and who is also associated with the British Loch Ness Investigation Bureau of London, hopes the new evidence will be sufficient to excite private and government sources of funding so that "more sophisticated ideas and equipment" can lead to "positive identification of these fresh-water inhabitants."

The New Dean on Deaning

Dr. Carola B. Eisenberg, who is beginning her first year as Dean for Student Affairs, says she is called "everything"—Dean, Dr., Mrs., even Ms. And she knows that—behind her back—some students call her "shrink"—a reference to her training and practice as a psychiatrist.

Only the last one concerns her, she told Peter M. Spackman of the M.I.T. News Office this fall in an interview for *Tech Talk*: she fears many students still adhere "to the notion of the all-knowing psychiatrist," and "I would not want anything to prevent any student's feeling free to come see me."

"If I had to have only one goal it would be to get to know lots of students very well. And my formal training as a psychiatrist is quite irrelevant to that, and indeed to most of deaning, if I can use such a word."

Here are some other responses from Dean Eisenberg to Mr. Spackman's questions:

What about "deaning"?

"There was one day when I thought it was being chief of the Bureau of Complaints—such a variety of problems . . . questions about the self—with those I was familiar. But the life of students is much more complex than that.

"This summer I was absorbed in letters sent to us by parents about their children who were coming to M.I.T. this fall—we ask them for comments and suggestions. The letters are honest, open, heart-warming. And the view they communicate of their children who are coming to M.I.T.—from an almost bewildering variety of backgrounds, I should say—are of young men and women who are, above all, committed people. Not an indifferent bunch, in their parents' view. Of course, they are committed to many different things, and I do not talk only of political commitment—although I think this generation is perhaps more connected to the outside world, more affected by political events, than we think—but of commitments to . . . well, to chess or to school or to art.

"The point is that, at least in their parents' eyes, these students are goal-oriented," Dean Eisenberg continued. "Of course they are at an age, a stage in human development, when the goals may

Three M.I.T. undergraduates attracted more than their share of attention last summer in the central Vermont-New Hampshire area by proposing highway alternatives near Woodstock, Vermont, and asking citizen participation in their planning. Here they are on a local radio show, "Rex Marshall's Breakfast at the Hanover Inn." By August they won the confidence of the Vermont Standard: *"They know more about our back roads and hillsides than we do and they have presented the facts to those interested in a manner which none can find objectionable."*

shift rapidly. One day this deep interest, another day that one. I don't think changing goals is nearly so important, particularly at this age, as that there are goals in the first place.

"Many people, incidentally, see students in terms of conflict and regard much of student behavior as acting out their conflicts. However, there is a big difference between action arising from inner tension and action stemming from inner conviction, from commitment to a goal, or from moral ideals. Only when you know a person very well can you be certain which sort of inner feeling is the cause of action, and I prefer to think that most student behavior comes from the natural and healthy commitment that is so evident in the letters I have been reading."

What about your goals as Dean?

"I have so many! It sounds like a cliche, but what I want to do is help improve the quality of the students' lives at M.I.T. I took this job partly because I was almost too comfortable in my previous one and partly because I wanted to help humanize this place. Learning should not—indeed, it cannot—stop in the classroom. And therefore students should have as rich and varied an experience as it is possible for older people to provide for them.

"The quality of learning at such an institution as this depends in great part upon what happens to students outside the classroom. These are terribly important years in human development. These are the years in which young people look behind their own familiar ways of life to decide what is important for themselves. Their goals should change and rechange as they examine themselves and their surroundings. Therefore what happens to them at M.I.T. is truly vital to who they are to become.

"I am optimistic about young people today. And in this time of looking inside, I want to help give them as many chances to measure themselves as a place such as M.I.T. can afford."

A Lesson in the Philosophy of Vermont: People vs. Highways . . .

That battle is being fought almost everywhere. What could three M.I.T. students and their instructor who inserted themselves into the Woodstock, Vermont, action of the people vs. highways campaign last summer in fact accomplish?

The story is the second chapter of M.I.T.'s cooperation with the Ottauquechee Commission (*see "M.I.T. and the Ottauquechee" in* Technology Review *for February, 1972, pp. 85-86*). The assignment of the summer of 1972 was a planning study of traffic problems on Route 4, the main east-west link between White River Junction and Rutland, where it threads the valley through Woodstock. Three students—Daniel S. Greenbaum, James G. Osborn, Jr., and George F. Smith, Jr., all seniors with majors in civil engineering and/or city and regional planning—took on the job with John B. Wilbur, '26, Professor of Engineering, Emeritus.

They soon agreed on four alternatives to be compared with the status quo: "spot" improvements to eliminate traffic bottlenecks and slowdowns; general reconstruction along the present route; creation of a by-pass highway; and improvement of alternate routes north of the Ottauquechee Valley. And they resolved to make community interaction with their work a primary goal.

The result was a busy summer of traffic studies, engineering surveys, radio appearances, letters to editors, and public hearings. The students quickly discovered that the "spot" improvements alternative was the easiest to live with—everyone recognized there were problems but many people were emotionally committed to the status quo. But the most important lessons had nothing to do with engineering.

"When we began the study," writes Professor Wilbur in his report to Peter S. Eagleson, Sc.D.'56, Head of the Department of Civil Engineering, "we thought of civil engineering as the traditional technical-functional-economic complex—along with which it was necessary, today, to give consideration to social and environmental impacts. But as the summer progressed we realized that it was more than this, that we were looking at civil engineering in a more unified way.

"We were realizing more fully than we ever had before that social and environmental considerations are an inescapable part of civil engineering itself, that it is this indivisible technical-functional-social-environmental-economic whole that is in our minds when we speak of civil engineering today."

China: Optimistic, Pragmatic, and Independent

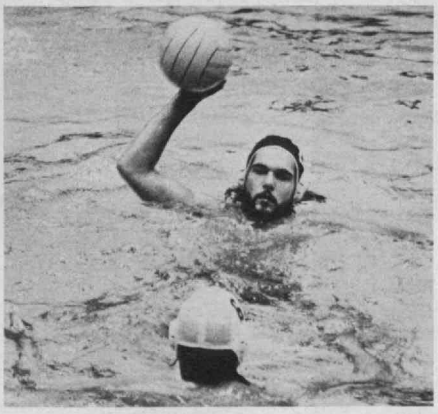
Chia-Chiao Lin, Institute Professor and Professor of Applied Mathematics at M.I.T., left China in 1940 as a 20-year-old mathematics graduate; 32 years later, he and a few similarly expatriated American university professors returned last summer with their families to visit the scenes of their youth. They found wide misunderstanding of America—but a self-reliant, self-confident people, proud—but not immodest of their growing accomplishments.

Professor Lin insists on his amateur status as a China-watcher; he cannot draw from his visit an analytical report on China, if only because the experience of returning to one's homeland after more than 30 years is a "multidimensional emotional one that cannot be reduced to a linear order." But here are some of his observations:

☐ The spirit of China has changed in 30 years from negative to positive; the country is no longer dependent on imports for its basic needs, and it is rapidly achieving independence in even the products of high technology. When it happened 12 years ago, Khrushchev's withdrawal of Russian support for Chinese technology plunged the nation into confusion; now the Chinese are grateful to the U.S.S.R. for forcing their country to become independent.

☐ Education is less changed than Professor Lin expected. In the high school from which he graduated, Professor Lin found a class studying the same poetry he remembers studying, with the same social interpretation. A mathematics class was at work on Euclidean geometry—still receiving a more classical mathematics education than is typical in the U.S. One great change: in high school, as everywhere else, the Chinese are trying to cultivate respect for manual labor and skills. Every high school has a machine shop and a small farm (or perhaps a large garden). Every student works one month in the shop and on the farm—in addition to eight months of classes and two months of vacation. Professor Lin judges that the whole represents "quite a solid high school education."

☐ The universities are only now recovering from the moratorium of the "cultural revolution." There is new emphasis on industrial needs and on relating theory to practice; the university



Two views of the 1972 fall sports season: the skipper in the lead is Maria Bozzuto, '73, who led the women's sailing team to six regatta championships this fall; and the offensive water polo star is David L. Rose, '74, the team's chief penalty shooter who led its attacks through most of the fall season. (Photos: Margaret Foote and David M. Tenenbaum, '74)

course has been reduced from six years to three or perhaps four; science and engineering textbooks stress the applications of technology. But the older, classic texts are still in the libraries, still valued and used.

☐ Though Professor Lin and his family were free to move about the country at will, he felt he had "only limited opportunity to observe the nature and level of professional activities." But he judges Chinese scientists and engineers are well informed; in general, they are working on the same kinds and levels of problems as their counterparts in the U.S. Their libraries are up to date; European scientific journals reach China about two weeks after publication, American journals in three to four weeks. Professor Lin saw one numerically controlled milling machine, several transistorized computers, and one computer using integrated circuits—all of them made entirely in China.

☐ China's present economy is consumer-oriented. Its priorities are to agriculture, light industry, and heavy industry in that order. And if the products of industry seem small by Western standards, remember that Western standards are hardly those of the Chinese. China's steel production, for example, is only one-fifth that of the U.S.; but it is 10 times more than China produced 30 years ago when Professor Lin last saw his homeland. And it includes the highest quality steels the Chinese believe they need.

Indeed, said Professor Lin, he found himself "deeply impressed" by the 30-year transition.

At Best a Mixed Bag . . .

. . . is a fairly charitable way to describe the 1972 fall sports varsity sports season at M.I.T. Here's a summary, including quotations from the account by Fred H. Hutchison, '75, David I. Katz, '75, and Sandra G. Yulke, '74, in *The Tech;* Miss Yulke is *The Tech's* Sports Editor.

The varsity sailors (men's team) entered 20 regattas and came out with six trophies, the Wood, Hoyt, Fowle, Staake, Oberg, and Schell. The last-named was their "most impressive victory of the season as the Tech varsity sailors defeated the nearest rival by 42 points."

Meanwhile, the women's sailing squad "had one of its best seasons ever, placing first in five of the eight major regattas it participated in." To Maria Bozzuto, '73, goes "major credit"; she sailed to five victories and finished first in the New England Single-Handed Championships.

For the soccer team it was six wins and eight losses, "their best season in eight years." One loss (Harvard) and one win (Holy Cross) in September, five wins and three losses "in close contests" in October, and no wins ("these games were all decided by one goal") in November.

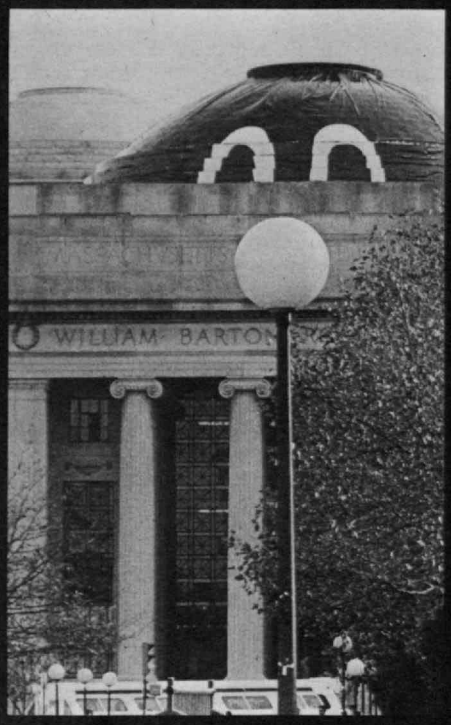
The water polo team won six out of 13, and there were frustrations—such as at the Easterns being "plagued by errors of the scorers and referees, including having to play two games with only an hour's rest between them."

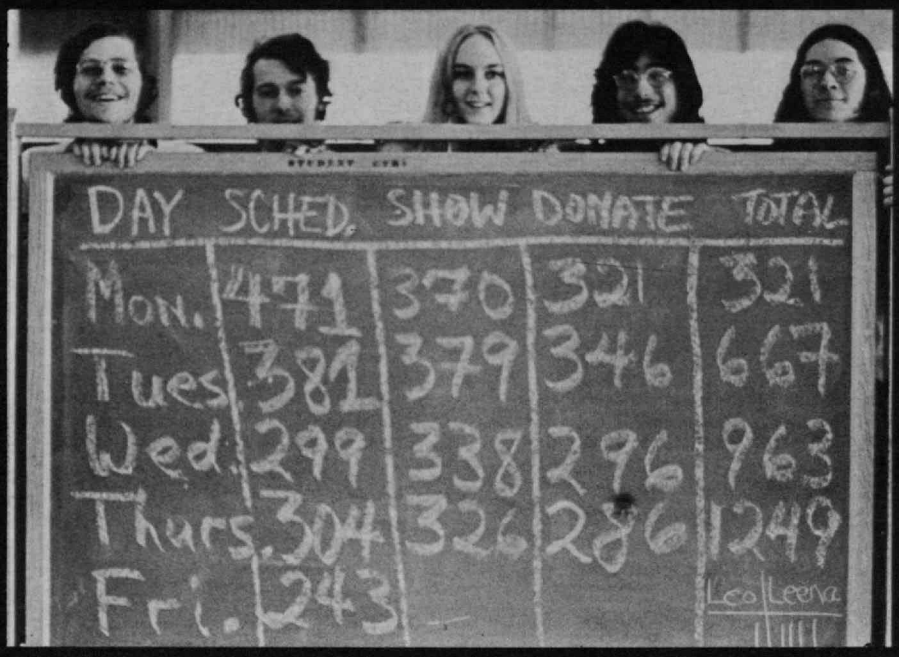
In cross-country, another disappointment: "the thinclads, plagued by injuries throughout the season, were only able to compile a 3-6 won-lost record, compared to the 11-2 compiled by last year's varsity."

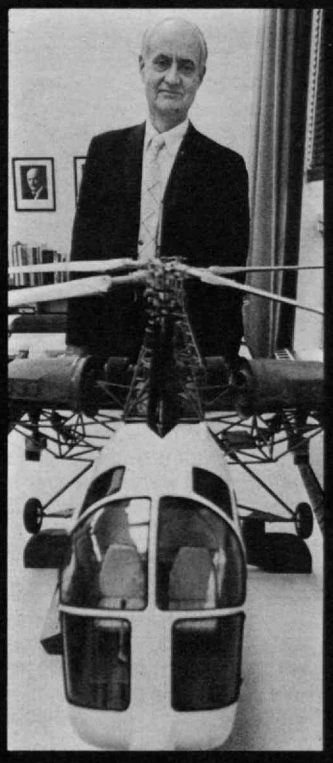
Baseball in the fall? Yes, indeed, and it was a winning (6-3-1) season, though the team "was plagued at times by inconsistency."

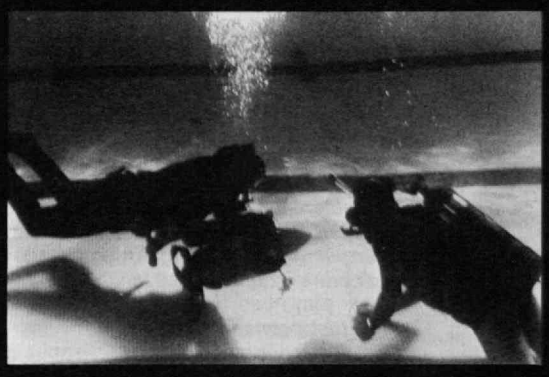
Like baseball, fall crew is more an exercise in preparation for the spring than a first-run show. Most of the tests come in the "Head of the Charles" regatta, in which a four-oared varsity boat won in its class, other heavyweight entries did well, lightweight eights finished third and sixth, and freshman heavyweights scored "a disappointing average finish." But there were a few other high spots: "a stunning

The Gallery









Some highlights and lowlights of late fall at M.I.T., clockwise starting with the picture above:

☐ *The dawn of Halloween found the Rogers Building dome encased in plastic and raising its eyebrows toward the West Campus.*

☐ *In the middle of the last day, students responsible for the fall Red Cross blood drive posed with their results. The final total was even better—a record 1,524 pints.*

☐ *Stephen Nuding, '74, found his role as King Arthur in the Musical Theater Guild's production of Camelot rewarding —at least for this moment of homage to Guenevere, played by a nonstudent actress from a local voice school.*

☐ *What do you do with an obsolete telephone switchboard? Here is Dennis O'Day of New England Telephone and Telegraph demonstrating the answer, M.I.T. having switched its telephones to a Centrex system: cut up the cables so their copper can be recycled.*

☐ *Bob Marcusson of IPC Magazines in London called with an urgent request— some kind of a book about ecology and economy written at M.I.T.? Heddy Richter of the M.I.T. Libraries' Reference Desk found it quickly enough, then was surprised with a bouquet of thanks from London.*

☐ *The widow of its inventor, Mrs. Kathrine Sergove Sznycer, has given Rene H. Miller, Head of the Department of Aeronautics and Astronautics, a model of the BS-12DI "Omega" helicopter.*

☐ *An advanced divers' program for experienced scuba devotees now meets regularly at the Alumni Pool. (Photos: Margaret Foote, Marc PoKempner)*

victory" in the intermediate fours for the varsity lightweights at Lowell Tech's Fall Festival regatta, the freshman lightweights' "wipeout" of Harvard, and the freshman heavyweights' 12-second victory over Boston University.

Golf—not to be forgotten—came out with a 3-3 season.

On Saving Utilities

"God! Is it cold in this building!"

The quotation is from Constantine B. Simonides, Vice President, and it is published here—though a bit out of context—only partly in jest. For M.I.T. has in fact achieved notable savings in utility costs since a conservation effort was mounted in March, 1971, and isolated examples of hardship, if rare, are not utterly unknown.

During the first year of the program, steam consumption decreased 52.5 million pounds. At the rate of $1 per 1,000 lbs. of fuel, the Institute saved roughly $52,500.

There have been "dramatic" savings of electric energy—an average decline of 165,000 k.w.h./mo. Until 1971-72 energy consumption had been growing 5 per cent a year; but the trend was reversed to a 2.1 per cent decline in that year, for savings of some $150,000.

Can They Do One Year's Work In a Summer, Two Years' Work in One?

Perhaps those questions overstate the case—but only a little. The answer is, Yes—at least for 32 students in the one-year accelerated Master's program of the Sloan School of Management. Basking in success, the School thinks it a useful pilot experiment toward the higher efficiency for which everyone searches in higher education.

The experiment began last summer after two years of study. Two goals were stated:

☐ The usual Master's-degree program in the Sloan School takes two years—four terms. Could the process be speeded up for highly motivated students who—because they were already employed, because their financial resources were limited, or whatever—wanted to finish more quickly?

☐ Could Sloan School classroom, computer and laboratory facilities be utilized more completely—especially in the summer?

The one-year program includes full-time study throughout an entire calendar year, beginning in June. Students in it take almost all the subjects included in the conventional two-year curriculum, simply working harder, carrying heavier loads than the two-year students. Most of the acceleration affects the core subjects typical of the first half of the Master's program. The one-year students take these in the summer—when the greatest speed-up takes place.

With the critical first summer of the program complete, the Sloan School is ready to call the one-year Master's program a success.

Thomas M. Hill, Associate Dean for Administration, thinks two factors are responsible for the students' accomplishments: they are highly selected, more mature than typical Sloan School Master's entrants; and most of the core program was given last summer on a self-paced basis with tutorial assistance.

Both faculty and students are recorded as "generally well satisfied, and most of them are enthusiastic," Professor Hill says. John F. Rockart, Ph.D.'68, Associate Professor of Management who taught information and decision systems during the summer, says, "The learning experience was clearly one of the best that I've seen from both a faculty and a student viewpoint."

Faculty found the self-paced teaching a useful experiment. Professor Gordon M. Kaufman, whose subject is mathematics for management, says, "The outcome suggests that we should restructure our approach to the substance but not the form of what we teach." Indeed, some members of the faculty think the need to revise courses may have been the most significant discovery of the experiment.

Convinced on the basis of the first two-thirds of the pioneer experimental program, the Sloan School now announces that it will repeat the one-year format for another 30 to 35 applicants who will enter in June, 1973. And by June, 1974, the one-year plan will probably be a standard feature of the Sloan School curriculum, with perhaps 60 students.

Did You Study with the Late Warren S. McCulloch? If So . . .

. . . you may have something that will help his widow, Mrs. Rook McCulloch.

Mrs. McCulloch is collecting papers and recordings of Dr. McCulloch's lectures and discussions as a member of the staff of the Research Laboratory of Electronics from 1951 to 1969. She hopes to prepare a volume of collected papers and will appreciate hearing from anyone who can help make available any such materials for copy or purchase. The address is Whippoorwill Road, Old Lyme, Conn., 06371.

John J. Rowlands, 1892-1972

John J. ("Jim") Rowlands, who was Director of the News Service at M.I.T. from its inception in 1925 until his retirement in 1957, died at the Massachusetts General Hospital on November 16, 1972; he was 80.

When he joined the Institute, Mr. Rowlands was one of the first men to occupy a full-time post in press and public relations in any U.S. educational institution. He reported to the newspapers on the selections of Karl T. Compton and James R. Killian, Jr., '26, to be Presidents of the Institute, and he interpreted for the press such M.I.T. achievements as the Van de Graaff generator in the early 1930s, the pioneering differential analyzer of Vannevar Bush, '16, and the high-resolution spectroscopy of George R. Harrison, who later became Dean of the School of Science. In 1949 he made arrangements for coverage by a large press corps of M.I.T.'s Midcentury Convocation, which included two appearances by Sir Winston Churchill.

Born in Aberdeen, N.C., Mr. Rowlands attended Staunton Military Academy, Fishburne Military Academy and the Meisterschaft School in Toronto, Canada. Then came a period as a mining surveyor and gold prospector in the North Woods of Canada and three years of service with the city of Toronto and its Harbor Commission.

Mr. Rowlands entered newspaper work in 1915 on the *Springfield Union*. Later he worked for the United Press in New York, was for six years New England and Eastern Canadian manager for United Press, and served as Managing Editor of *National Sportsman* magazine. Working with the United Press, Mr. Rowlands was the first person to reach Vice President Calvin Coolidge in Vermont with the news that President Warren G. Harding had died.

A keen observer of everything around him and an expert in handcrafts and woodcraft, Mr. Rowlands continued for many years a "Cache Lake Letter" reporting North Woods lore in a uniquely warm but restrained style; in 1947 these notes were supplemented and collected into a book, *Cache Lake Country*. In 1960 came *Spindrift*, a further collection of reminiscences. In all of these activities Mr. Rowlands had the close collaboration as illustrator of the late Henry B. Kane ('24), the first Director of the M.I.T. Alumni Fund. He also contributed to the *Atlantic Monthly* and other magazines.

Mr. Rowlands came to M.I.T. at a time when science was becoming an increasingly important subject in the news. His sure eye for the dramatic yet human dimensions in science was coupled with an insistence on accuracy; even the simplest news release was an object of care and refinement. Mr. Rowlands' reporting of Institute affairs for *Technology Review*, of which he was Contributing Editor from 1925 to 1932 and Editorial Associate from then until 1958, brought distinction to this magazine.

"Jim" Rowlands was a friend of hundreds of members of the press. In 1950, Edward A. Weeks, former Editor of the *Atlantic Monthly*, wrote, "In my judgment the best public relations in the college world over the past 25 years have been those maintained at the Massachusetts Institute of Technology." And at the time of Mr. Rowlands' retirement, Dr. Killian, then President of the Institute, wrote that "the Institute will long be grateful for the high standard he set in interpreting M.I.T. and technical education to the country."

Gilbert M. Roddy, 1910-1972

Gilbert M. Roddy, '31, a Life Member of the M.I.T. Corporation since 1962, died on October 15 following a long illness. He was 61.

Mr. Roddy spent virtually all of his professional career with the Arkwright-Boston Insurance Co. and two of its predecessor companies, having joined the Boston Manufacturers Mutual Insurance Co. as a security analyst in 1934. He was elected President and Chief Executive Officer of that company in 1958 and of the Arkwright-Boston Insurance Co. in 1968, and he became Chairman of the Board of Arkwright-Boston in 1971.

Howard W. Johnson, Chairman of the M.I.T. Corporation, notes that Mr. Roddy was one of several M.I.T. graduates who, upon entering the fire insurance industry, "pioneered in the establishment of a sound engineering basis for the evaluation of fire risk in industrial operations."

Mr. Roddy was President of the M.I.T. Alumni Association in 1957-58; he served a total of 11 years on the Audit Committee of the M.I.T. Corporation, and he also served on a number of its Visiting Committees. He held two degrees from M.I.T. in business and engineering administration—S.B. (1931) and S.M. (1932). As an undergraduate he joined Phi Gamma Delta fraternity, and he was active in securing resources for fraternity housing at M.I.T., recently (1964-1967) as a Trustee of the Independent Residence Development Fund.

Memorial contributions have been designated by Mr. Roddy's family for the Gilbert M. Roddy Alumni Scholarship at M.I.T.

Harlow Shapley, 1886-1972

Harlow Shapley, Paine Professor of Practical Astronomy, Emeritus, at Harvard University who had been a Life Member of the M.I.T. Corporation since 1932, died in Boulder, Colo., on October 20. He was 86.

The *New York Times* called him "the dean of American astronomers," and *American Scholar*, in dedicating an issue to him last year, said that Dr. Shapley

"belongs alongside Galileo, Copernicus, Kepler, Newton and Einstein."

Dr. Shapley joined the M.I.T. Corporation in 1932, when Karl T. Compton, M.I.T.'s ninth President, was undertaking to extend graduate studies, basic research, and academic work in science at the Institution to which he had come as President only two years before. Indeed, Howard W. Johnson, Chairman of the M.I.T. Corporation, noted that "the establishment of the Graduate School at M.I.T. in 1932 was substantially aided by the help given to Dr. Compton by Dr. Shapley and other leading scientists and educators."

In 25 years of active membership on the Corporation, Dr. Shapley served as Chairman of several Visiting Committees; he became Life Member Emeritus at the time of his retirement from Harvard in 1957.

Dr. Shapley studied at the University of Missouri (A.B. 1910, A.M. 1911) and Princeton (Ph.D. 1913), and he came to Harvard in 1921 as Director of the Harvard College Observatory. From then until his retirement, he worked to extend the Observatory's activities and increase its research, to improve public understanding of astronomy, and—in more recent years—for liberal political, international, and humanitarian causes. He had been President of the American Association for the Advancement of Science and of the American Academy of Arts and Sciences, received 18 honorary degrees, and held membership in a large number of honorary and learned societies.

Dr. Shapley leaves his widow, four sons (all of whom are in careers in science and education), a daughter, and nine grandchildren (one of whom is Deborah Shapley, former Associate Editor of *Technology Review* who is now on the staff of *Science* magazine).

Shri Krishna Singh, 1952-1972

Shri Krishna Singh of Lucknow, India, a graduate student whom colleagues described as demonstrating "all the qualities of being an outstanding scientist" suffered a fatal electrical shock in an M.I.T. laboratory on October 16. He had come to the Institute a year before at the age of 19, having completed studies at the University of Lucknow (S.B. 1968) and the Indian Institute of Technology, Kanpur (M.S. 1970).

Mr. Singh was working with a gas laser operating at 4,000 volts when he apparently came accidentally into contact with a charged metal plate at one end of the apparatus. He was given emergency aid in the laboratory and at Mt. Auburn Hospital, but he died about four hours after the accident.

Ali Javan, Professor of Physics with whom he was studying at M.I.T., said Mr. Singh's memory "will inspire our work . . . and our lives." Professor Javan and his colleagues pledged themselves to continue Mr. Singh's experiment and publish the work as a memorial.

Individuals Noteworthy

Awards and honors: **John R. Schrieffer**, '53, the 1972 Nobel Prize in Physics for his development of a microscopic theory of superconductivity. . . . the Outstanding Patent Award of the New Jersey Council for Research and Development to **Amos E. Joel, Jr.**, '40 . . . **David G. Hoag**, '46, and **Richard H. Battin**, '47, the American Institute of Aeronautics and Astronautics' Louis W. Hill Space Transportation Award for 1972 . . . to **John Sevier, Jr.**, '51, an Exceptional Service Medal from the National Aeronautics and Space Administration . . . **Chang Mu Kang**, Ph.D.'72, the Mark Mills Award from the American Nuclear Society . . . **Edward W. Merrill**, Sc.D.'47, the "Outstanding Faculty Award" from the M.I.T. Department of Chemical Engineering . . . to **Chee Yee Chong**, '70, Honorable Mention from the American Automatic Control Council at their 1971 Joint Automatic Control Conference . . . to **Hans Mark**, Ph.D.'54, the Medal of Distinguished Service from the National Aeronautics and Space Administration . . . The Annual Achievement Award of the National Fluid Power Association to **J. Lowen Shearer**, Sc.D.'50 . . . to **Thomas K. Sherwood**, Sc.D.'24, the Warren K. Lewis Award of the American Institute of Chemical Engineers . . . **Charles Stark Draper**, '26, the 1972 Award of Merit from the American Institute of Consulting Engineers . . . to **Courtland D. Perkins**, S.M.'41, the Exceptional Civilian Service Decoration from the U.S. Air Force . . . the Dr. William E. Upjohn Award from the Upjohn Company to **Jackson B. Hester, Jr.**, '55 . . . to **Emily L. Wick**, Ph.D.'51, an honorary Sc.D. degree from Mount Holyoke College . . . the Atomic Energy Commission's Enrico Fermi Award for 1972 to **Manson Benedict**, Ph.D.'32 . . . to **Theodore P. Yurkosky** S.M.'69, the U.S. Air Force Commendation Medal.

Professional and corporate changes: **Seymour L. Blum**, Sc.D.'54, to Director of Advanced Program Development for The MITRE Corporation . . . **John R. Wiley**, '33, to the Board of Directors of J. E. Greiner Co., Ltd. . . . **Robert G. Loewy**, S.M.'48, to succeed **Courtland D. Perkins**, S.M.'41, as Chairman of the U.S. Air Force Scientific Advisory Board . . . **George B. Field**, '51, to Director of the Smithsonian Astrophysical Observatory . . . **George R. Berbeco**, '66, to head a new economic stimulation program for the City of Boston . . . **John J. Buckner**, S.M.'60, to Controller, Eastern Gas and Fuel Associates . . . **Fred S. Wojtalik**, S.M.'69, to Director for Application Engineering and User Information at the N.A.S.A. Marshall Space Flight Center . . . **Frank W. Tyaack**, '50, to General Manager of the Process Equipment and Systems Divisions of Westinghouse Electric Corp. . . . **Irvine F. Williamson**, '50, promoted to Plant Manager, Vitrified Products, of Norton Co.'s Grinding Wheel Division . . . **Rolf T. Skrinde**, Ph.D.'52, to Vice President of Reynolds, Smith and Hills . . . **Robert J. Reille**, '44, to Vice President, Imperial Chemical Industries—America . . . **Robert L. Johnson**, '38, to President of Arkwright-Boston Manufacturers Mutual Insurance Co. . . . **Richard P. Simmons**, '53, to President of the Allegheny Ludlum Steel Corp. . . . **Alfred E. Perlman**, '23, to Chairman and Chief Executive Officer of Western

Pacific Railroad Co. . . . **William Papian**, '48, to Visiting Scientist at the Health Services and Mental Health Administration . . . **Stephen S. Flaum**, '67, to Manager of the Engineering Department of S. and S. Corrugated Paper Machinery Co. . . . **Carl P. Slenk**, '56, to Manager of Electric Products, Carborundum Co. . . . **Curtis D. Blaine**, '68, to Manager of Performance Data, Medicare Division of the Blue Cross Assoc. . . . **Gregor F. Meyer**, S.M.'32, President of the Pennsylvania Savings and Loan League.

Professional societies: **Gerald A. Lessells**, '50, elected a Director of the American Institute of Chemical Engineers . . . **Frank Press**, Head of the M.I.T. Department of Earth and Planetary Sciences, President-elect of the American Geophysical Union . . . **Michael Athans**, M.I.T. Professor of Electrical Engineering, elected President of the Control Systems Society of the Institute of Electrical and Electronic Engineers.

University appointments: **Rai Y. Okamoto**, M.A.R.'51, to Visiting Professor in Department of Architecture, M.I.T. . . . **Henry Cohen**, M.C.P.'44, appointed Dean of the Center for New York City Affairs at the New School for Social Research . . . **Robert Mehrabian**, '64, to M.I.T. Assistant Professor of Metallurgy . . . **Carl F. Long**, '50, Associate Dean of Dartmouth College, to Dean of its Thayer School of Engineering . . . **Michael J. White**, '65, to the Political Science Department of Syracuse University . . . **Edward D. Kalachek** Ph.D.'63, to Head of the Department of Economics, Washington University. . . . **Barry L. Karger**, '60, to Professor of Chemistry at Northeastern University . . . **C. B. Smith**, '42, to Director of the Research and Development Incentives Office of the National Science Foundation . . . **James F. Burns**, Ph.D.'67, to Associate Director of the University of Florida's Division of Planning and Analysis . . . **Earl W. Adams, Jr.**, Ph.D.'63, to the Andrew Wells Robertson Chair of Economics at Allegheny College . . . **Gordon O. F. Johnson**, '48, President of LogEtronics Inc., to Virginia Governor Linwood Holton's Advisory Board on Industrial Development . . . Dr. **Harry W. Fritts, Jr.**, '43, named first incumbent of the Dickinson Richards Chair in Medicine at Columbia University.

Deceased

Charles F. Whiting, '99, October 23, 1972
Clarence M. Hardenbergh, '03, September 9, 1972
George M. Bates, '04, November 12, 1972
Harry H. Needham, '04, September 31, 1972
Herbert W. Kenway, '05, October 22, 1972*
Edwin B. Bartlett, '06, August 18, 1972
Hudson B. Hastings, '07, November 23, 1972
Marshall E. Comstock, '11, November 13, 1972
Luis R. Gonzalez, '12, August 2, 1972*
J. Murray Hastings, '13, November 6, 1972
Mrs. H. M. Varrell, '14, October 23, 1972
Henry E. Berger, '15, October 31, 1972
Rush B. Cady, '15, July 17, 1972
Clifton N. Jacobs, '15, November 9, 1972
Paul Gardner, '17, September 11, 1972*
Alfred Pierce, '17, August 25, 1972*
Roger L. Putnam, '17, November 24, 1972
Harold Connett, '18, July 14, 1972
Lloyd R. Sorenson, '19, June 30, 1972
Edward M. Howard, '20, February 28, 1972
George E. Rowe, '20, September 26, 1972
Frederick W. Adams, '21, October 22, 1972*
Mrs. William C. Richardson, '22, May 23, 1972
Wanton E. Gladding, '23, November 12, 1972
Robert W. Hughes, '23, November 7, 1972
James H. Shapleigh, '23, January, 1969
Stanwood E. Whitcombe, '23, November 14, 1972
Gerald L. White, '23, January 20, 1972
William L. Gilliland, '25, May 6, 1971
Edward H. Hagstrom, '25, September 19, 1972
Louis V. Wilcox, '26, August 20, 1972
J. Sellers Bancroft, '27, April 26, 1972
William J. Rudge, Jr., '27, October 30, 1972
William E. Hutchinson, '28, November 16, 1972
John A. Kelley, '28, February 8, 1971
Charles O. Glisson, '29, August 15, 1972
Ross M. Pfalzgraff, '29, September 30, 1972
Philip J. Riley, '30, September 9, 1972
Arthur J. Demars, '31, September 28, 1972
F. Francis Donaghue, '32, October 26, 1972
Philip A. Daniel, '34, October 28, 1972*
William D. Kiebler, '35, September 30, 1972*
Charles H. Fager, '37, October 6, 1972
Milton I. Wallace, '38, May 12, 1972
Walter E. Morton, Jr., '41, November 17, 1972
Richard B. Small, '42, October 30, 1972
Beatrice H. Worsley, '47, May 8, 1972
Harold D. Kilgord, Jr., '48, November 17, 1972
William M. Cowan, Jr., '59, November 16, 1972
Robert J. Keene, '59, October 5, 1972
John R. McAllister, '62, October 28, 1972
Sea B. Chang, '63, November 19, 1972

* Further information in *Class Review*

Class Review

96

Birthdays are our chief item of news this month with our best wishes going to the youngest member of the Class, **Walter O. Pennell**. He will be 98 on January 13. . . . Your Secretary stopped to congratulate Dr. **William Coolidge** the day before his 99th birthday and found him enjoying a family reunion. His daughter and son-in-law had come from Oregon for the occasion and were joined by their daughters and grandchildren, so all four generations were on hand for a real celebration.—**Clare Driscoll**, Acting Secretary, 2032 Belmont Rd. N.W., Wash., D.C. 20009

98

Happy New Year time again—to **Alvan Davis**, **Bob Lacy**, **George Newbury**, **Joe Riley** and to our honorary member, **George Harrison**. This year of 1973 brings our 75th Reunion! Can you attend it in June by plane or cane?—**Mrs. Audrey Jones Jones**, Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

99

A letter has been received from **Frederick W. Grover** of Howard Gap Lodge, Lynn, N.C. In the past, Fred has been a great traveler. He was always present at the alumni gatherings. He wishes he might continue coming to the Class Reunions but unfortunately, his doctor will not permit him. He sends greetings to all members.—**Norman E. Seavey**, Acting Secretary, Apt. 514, Lucerne Towers, Orlando, Fla. 32801

05

It is my sad duty to tell you that our President, **Herbert W.** (Hub) **Kenway**, died on October 22, 1972, after a long illness during which he fought off one attack of pneumonia but succumbed to the second. Hub was undoubtedly one of the finest patent attorneys in at least the New England area. For many years he was the "chief" for the United Shoe Machinery Co.; later as Senior Partner for Kenway, Jenney, and Hildreth, he handled the patent affairs for the Gillette Safety Razor Co., attending to important matters by going to his Boston office daily until the Spring of 1971. He leaves a son, Herbert P., who has been a junior partner in the firm for many years; a daughter, Mrs. Margarett Hayden, of Beverly; and six grandchildren; he leaves a widow, Helen (Marcy) Kenway, who is in very poor health.

Hub has been our President since our 50th Reunion. His death leaves a gap which will be hard to fill. Unless someone volunteers, I will carry on to the best of my ability. This brings up another question. The treasury is very low. It seems a bit odd to declare an assessment (we are now 29 in number), but voluntary contributions might be a good way to keep your Secretary in position to take care of office expenses.

A letter from **Roy Allen** tells us that his surgeon-doctor felt he could go to Cambridge, N.Y., for Grace's memorial service and burial in the Old Friends Cemetery in Easton, N.Y. Roy's foster daughter flew to Phoenix, Ariz., flew with him to New York, then accompanied him back to Phoenix. Our sympathy has been with Roy since that terrible accident last Spring. An extension of the above trip to Cambridge, Mass., and his "last look" at M.I.T. assures us that Roy has returned to fairly good health. . . . Recently, due to the fact that he and Helen had not made their customary fall trip to New Hampshire, I called **Dean Klahr** in Erie, Pa. Dean had had a partial shock, but had recovered sufficiently to seem in pretty good condition. He still retains his job as "viewer" in his County in spite of his politics. "Just too stubborn to resign," he says. . . . **Herb Bailey**, in response to a birthday card writes, "If I could only make myself take more exercise, I would not be so lazy, but I just eat, sleep, look at TV, read, and play with my stamp collection." Most of use are in the same easy chair, Herb.

These notes will not reach you until after the Christmas and New Year's greetings have sounded, but please consider that my personal greetings and a hope for good health have been wafted in the air even before Thanksgiving time. Ruth and I will be surrounded by three daughters, two sons-in-law, and five grandchildren on Thanksgiving Day, and regretfully but hopefully I say—no great, great grandchildren.—**Fred W. Goldthwait**, Secretary, Box 231, Center Sandwich, N.H. 03227; **William G. Ball**, Assistant Secretary, 6311 Fordham Place, Bayshore Gardens, Bradenton, Fla. 33505

07

We are sad to report the death of an '07 classmate, Professor **Hudson B. Hastings.** *The New Haven Register* of November 24, 1972, states that Professor Hastings passed away on November 23, 1972. Born in Walpole, N.H., Professor Hastings graduated from Phillips Exeter Academy and after graduation from M.I.T. was an instructor in drawing and surveying at Bowdoin College. He was a member of Admiral Perry's North Pole technical staff in 1910. Professor at Reed College in Oregon until 1920, Professor Hastings then served as a research economist for the Pollack Foundation for Economic Research at Newton, Mass. He was appointed Professor of Industrial Administration in the Sheffield Scientific School at Yale. In 1938 he became Professor of Economics at Yale and Chairman of its Department of Industrial Relations until his retirement in 1954.

Professor Hastings served as President of both the New Haven Community Chest and its Y.M.C.A. He was a member of the Republican Economic Advisory Committee in 1936 and President of the Yale Cooperative Corporation. He leaves his widow, Rena Porter Hastings, two sons and two daughters, six grandchildren and two great-grandchildren.—*M.K.*

09

In the December *Review* we told of the death of Davis R. Dewey, son of Brad and Marguerite. We wrote to Brad expressing the sympathy of the Class and have this reply. "As to news of me, I am leading a very quiet life up here in New London, N.H. Marguerite and I are living in Dad's and Mother's old farmhouse. It is on the top of Burpee Hill overlooking Lake Sunapee—a beautiful view. I try to get down always to the Tech Corporation meetings. These meetings are very interesting and we certainly have a wonderful group of men taking care of the management of M.I.T."

All of us are aware of Brad's distinguished career. Brad is co-founder of the

great Dewey and Almy Chemical Co., a life member of the M.I.T. Corporation, and a recipient of many awards and honorary degrees, including an L.L.D. from Harvard in 1945. During World War II he was Director of the Department of Rubber Production of the War Production Board.

In the December notes we told of the sudden death of **Tom Desmond**, our vice president, which occurred on Saturday, October 7, during the Annual Alumni Officers' Conference and we stated that a further tribute to him would appear in the notes this month. After writing to Alice, expressing the sympathy of the Class, we have received the following from her: "Many thanks for your letter with its several kind expressions. I am sending to you a few clippings from newspapers together with copies of the remarks made at the Memorial Service for Tom at St. George's Church by Chairman of the M.I.T. Corporation, Howard W. Johnson and Secretary of the New York State Senate, Albert J. Abrams on October 11." Tom was born in Middletown, N.Y., in 1887. He worked his way through Harvard from which he graduated magna cum laude in 1908. The following year he obtained his degree in Civil Engineering at M.I.T. After graduation he engaged in construction work in many parts of the country. He returned to New York in 1914 to become President of his own company, T. C. Desmond and Co., engineers and contractors, and in 1917 formed and became President of the Newburgh Shipyards, Inc. In 1930 he retired from business and began an illustrious career as a lawmaker and a civic leader in many philanthropic activities. He also made many valuable contributions to higher education. In 1930 he was elected a New York Senator, a position he held until 1958 when he retired as a senior senator. Tom sponsored and promoted much important legislation.

In 1923 he married Alice B. Curtis who became a noted author of over 20 historical books. He and Alice traveled extensively in Europe, Asia, and South America. Tom was a life member of the M.I.T. Corporation, a former President of the Alumni Association, at one time a member of the Visiting Committee of the Harvard Graduate School of Engineering, a Mason and an Elk, and a trustee of Union College which awarded him an honorary degree of Doctor of Humane Letters. He was also a member of the New York State Historical Society, Phi Beta Kappa, the American Society for Engineering Education, and a life member of the American Society of Civil Engineers and of the National Grange.

Howard W. Johnson concluded his eulogy at Tom's service with the following words: "We celebrate his professional achievement as an engineer, business man, and a public servant. We rejoice in his life-long dedication to science and education. We acknowledge our deep sense of loss in his passing and we join gratefully with his family and friends to rededicate M.I.T. to his ideals." Albert J. Abrams, Secretary of the New York State Senate concluded, "This globe's very future depends on men like Tom Desmond who are willing to devote themselves not to the pleasures of the world but to the needs of their fellow human beings." Both the Institute and the Class will greatly miss Tom's counsel and his influence. He was one of our most loyal members and was always present at our many Alumni Day gatherings, class meetings and reunions. Tom is survived by his wife Alice and a sister, Mrs. Catherine N. Costello of Wyndmoor, Pa.

Betty and **Art Shaw** left December 1, for their winter residence, the Ponderosa, 2509 Gulf of Mexico Dr., Longboat Key, Sarasota, Fla. The Class wishes them a most pleasant winter and good health.

We are sorry to report the death of **George Witmer** which occurred on January 14, 1972, at St. Petersburg, Fla., at the age of 87. His Course was electrical engineering and therefore well known to your Secretary. He was born in Washington, D.C. in 1885 and prepared for M.I.T. at St. Paul's School in Concord, N.H. As a student he was very active in the E.E. Society, Southern Club and Technique Committee. In 1910 he married Bella Stone who passed away about four years ago. After graduation George practiced electrical engineering in the Canal Zone and then in Mexico. In 1924 he returned to Washington and later, unfortunately, became semi-incapacitated and had to curtail his physical activities and professional career. At various times he and Mrs. Witmer lived in Florida in Orlando, Sandford and Ormond Beach and in Warrenton, Va. His last residence was at a Health Center in St. Petersburg, Fla. The January 1972 class notes has a photograph of George standing at the entrance to the Trinity Prep School at St. Petersburg with the name "George S. Witmer Science Building" (given by him) in large raised letters on the wall. Earlier he often mused "that even so, no one would ever know anything of George Witmer." Some years ago George and his wife gave the Institute a substantial trust fund. . . . We have also received notice of the death of **Edward P. Chapman**, which occurred on December 29, 1971, in Cleveland, Oh. He was born in 1887 in Pueblo, Colo. At the Institute, he was a member of the Mining Engineering Society and the class relay team. Until 1941 he was engaged in mining activities in Colorado after which he moved to Wash., D.C., where he joined the traffic department of the Metals Reserve Co. In 1967 he moved to Cleveland.—**Chester L. Dawes**, Secretary, Pierce Hall, Harvard University, Cambridge, Mass. 02138

10

Merrill W. Tilden, Class of 1910, married Laura Rhett Tilden of Chicago, February 8, 1911. He has one daughter, Virginia T. Burnham, a grandson, and a granddaughter. He retired as Vice President of Mitchell, Hutchins in 1970. He has been ill for the past year and a half and is confined to his home. He and his wife will celebrate their 62nd wedding anniversary on February 8, 1973.

Charles F. Robinson writes, "Thanks for your inquiry. I'm 84, retired, not affluent, nor on the welfare list. While far from being a superman, I still am able to drive my auto for shopping and short trips, and do the many small chores around the house. I am single, and with my sister, also single, we have lived at the same address for the past 56 years, which is quite a record for living so long in one place. We own the house, as our parents did. For a hobby when I have the time, I like to collect stamps. While my collection is neither large nor valuable, it is quite interesting to me, as many of my friends, in traveling about, send them to me. I belong to the A.A.R.P. (American Association of Retired Persons), a helpful organization of 4,000,000 people, and I hope many other old M.I.T. men do also. I have just learned of the death of classmate **Percy A. Falkenberg**, which I understand occurred in January 1972. I had not seen any notice in the class news. Now I hope you receive many replies from classmates, and that I may read about them in the 1910 section of *Technology Review*, which I receive regularly. Do you have any information concerning classmate **French P. Sargeant**, whom I have not heard of, or from, for many years. If he is among the '61,' do you know his address? I hope you are feeling well now, and that you will enjoy life in the years ahead."

Robert P. Waller writes, "I retired from active business at the age of 75 in 1959 but lived on in our home in Newton, Mass., until 1965 when taking care of a house became too much of a burden for both Mrs. Waller and me. In September of that year we bought a residence in The Presbyterian Homes of The Synod of New Jersey and have lived here ever since. The home has a residence capacity of about 400 people who come from almost every walk of life—doctors, lawyers, school teachers, librarians, business men and a few engineers. It is a very live and active group of people, ranging in age from 65 to well over ninety, and the home is most comfortable and attractive on a tract of about 105 acres partly wooded and with considerable well-kept lawns. I am still glad I can claim to be a graduate of M.I.T. and though my financial support has been on the decidedly slim side, I am glad to send a little each year to show I still have a feeling for M.I.T. I do think you are entitled to a word from each of us for I know what an apparently thankless task being a Secretary is."

J. O. Gawne writes, "I must plead too much that has to be done and too little competency to do it now that I am in my 90th year. I retired from the navy for physical disability in 1943, remained on active duty until 1945. Mrs. Gawne and I are both in reasonably good health. I still play what passes for golf with the aid of a cart, three times a week in a foursome about my age group (we do have one who is 81 whom we call Junior) and I enjoy it. We lost our son but we have one daughter, Christine, now Mrs. Paul M. Wick, who, with her husband, is living in Sewickley, Pa. They have four daughters. The oldest, Christine, married to an architect, has a Doctor's degree in literature and is teaching in the University of Georgia. The second, Laura, graduated from Smith and had her junior year at the University of Geneva, Switzer-

land and is now married to a Swiss and living in Geneva. The third, Wendy, is now at the University of Delaware taking a museum course under a Dupont Foundation. The fourth, Sandra, is a senior at Northwestern University. About the only one in 1910 that I see occasionally is Captain **A. B. Court**, U.S.N., Ret., known as "Doc" to his friends. He is in reasonably good health and, with Mrs. Court, lives in Annapolis, Md."

Stuart Chase gives a peppy response to our letter about the Class of 1910: "You asked me what I have been doing since I retired and I am glad to report that I have not retired! I am still pretty active with the Redding Planning Commission and still writing books and articles. I have, however, given up the lecture bureau circuit which was exhausting.

"I still play tennis, but only doubles, and no longer compete at the Country Club, but sit on the top of the high step-ladder and umpire in the town tournament.

"I have been enormously concerned and excited by the Club of Rome computer study carried on by Meadows and others at M.I.T. I believe it is one of the most important undertakings which our fine institution has ever sponsored. I have just published an article in the *Connecticut Review* entitled, "The Club of Rome and Its Computer." I intend to use this article, and a number of other articles, published and unpublished, in a new book of essays under the title of *Two Cheers for Technology*. With all best wishes."

Carl Lovejoy replied, "Your letter was amongst the two months' accumulation of mail that arrived during our trip to explore the country west of Florida. Only went as far as Colorado, Nevada, and back along the Gulf of Mexico. I was impressed with the Rockies and Grand Canyon. We visited such places as the Truman and Lyndon B. Johnson libraries. Went up about the snow line on a jeep tour, and threw snowballs at each other. First snow I had seen since retirement in 1956 and first for my wife in 36 years.

"Last Easter we explored the west coast of Florida and took in Disneyland. At home we have a large house and a large circle of friends, mostly retirees. In the winter we have visits from our northern relatives. I have very pleasant recollections of our 60th Reunion."

Harold E. Akerly writes "Your letter came just as I had decided to check on your health. Jess and I are happy to know that you are functioning. Our life slows a bit each year. This summer we missed our usual long weekend at the family compound in Brewster on the Cape. Next month we plan to return to Winter Park. Its proximity to Disney World is sometimes annoying but the merchants and the real estate operators on the contrary are happy. Survival in reasonable comfort is our present objective. We still look ahead."

Achilles Hadjisavvas notes a change of address and the following "I was very pleased to get news from you and the classmates of 1910. I underwent two operations during the last year, for hernia and the second for duodenal ulcer from which I have not yet recovered, so that I have to be bed-ridden most of the time as my legs do not yet obey my command. I receive regularly the *Tech Review* in which I learn always with much interest everything concerning the surviving classmates. I seize the opportunity to wish to everyone of them good health and possibly long life without the usual sufferings of the old age. Please accept my thanks for your thoughtfulness and my best wishes for your well-being."—**Herbert S. Cleverdon**, Secretary, 112 Shawmut Ave., Boston, Mass.

11

I have a few new addresses as the boys get settled in for the long pull: Roy D. Van Alstine, 3737 Atlantic Ave., Long Beach, Cal., 90807; Stafford A. Francis, 680 Highland Ave., Brooksville, Fla., 33512; General George C. Kenney, 10180 W. Bayshore Dr., Surfside, Fla.; Charles B. Magrath, Box 118, Winnetka, Ill., 60093.

A note from **Allston Cushing** reminds us that he was retired from the U.S. Department of Agriculture in 1950 when he was 60 years old; then held a job as Office Engineer on a $20,000,000 job rehabilitating a war plant 'til 1954. Since then he has worked at the job of maintaining a home, but on February 1 he is retiring to the John Knox Retirement Village with this new address: Apt. C204, 514 North Murray Rd., Lee's Summit, Mo. He is still active in the American War Dads.

Last month I noted the death of **Philip Caldwell**. Since then I have heard through **Harry Tisdale** that Phil's widow, Bobby, was up in New Hampshire last summer but is now back at home at 1613 Casey Key Rd., Nokomis, Fla., 33555. Harry, who is still active in the American Society for Retired People, is having the same trouble I am. We are both keeping house alone with the help of a woman one day a week. His helper was away for a long period last year and mine spent three months in Florida last winter and two in Prince Edward Island last summer. I much prefer to pay to have the house work done rather than do it myself.—**Oberlin S. Clark**, Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

We have received little news for this month's issue, except that from a few men who contribute regularly. I did receive several notes from those who attended the Reunion, telling how much they enjoyed it, and some urged that we consider another one in a year or two. Any comments?

Willis Salisbury writes that he is moving to a smaller appartment located next door in Minneapolis, but I do not have the new address. He spent the summer as usual in his cottage in the wild country at Hungry Jack Lake and again repeats his invitation for any classmates to visit him there. He went to Winterset, Iowa, where there was a covered bridge festival, and sent me clippings and a commemoration medallion. Willis plans another trip this spring, this time to Europe. . . . **Al Davis** spent a few days in the hospital this fall but has fully recovered. . . . **Ken Barnard** is well and is still working mornings as a consultant for the Colonial Candle Co., in Barnstable, Mass. . . . **Cy Springall** and Margorie took an extended trip last summer to the White Mountains and to Bangor and Southwest Harbor, Maine. They visited many friends en route.

Jim Cook visited with his daughter, Sue, in Wolfeboro, N.H., this fall. They then drove to Bar Harbor, Maine to see his other daughter and her husband. . . . **Jay Pratt** and Priscilla are keeping well. Jay worked daily in his large garden 'til fall, and Priscilla plays golf weekly, weather permitting. . . . **Cornelius Duyser** has kept busy making needed repairs to his home in New Hartford, Conn. His wife died several years ago and he continues to live there alone. . . . **Harold Brackett** and his niece, Eleanor Forbes, took a trout fishing trip to Sourdnahunk Lake in northern Maine last fall. They reported a fairly good catch and were able to bring some fish home. They drove home to Oradell, N.J., just before Halloween. They plan a vacation to Florida this winter as usual.

Jesse Hakes and Mary plan another long cruise this winter and Dorothy Cremer, widow of **Randall Cremer**, writes that she intends to do the same, possibly with the Hakes, as she did last year. . . . We have had no direct word from **Dolph Martin** but understand he is well and able to continue his trips to London concerning his very successful orchestral work. . . . A letter from the wife of **Luis Gonzales**, who lives in San Juan, Puerto Rico, says that Luis is totally incapacitated and uses a wheel chair. Our deep sympathy and best wishes to you, Luis.

Following Helen's sudden passing last October, I have decided to continue to live here in Swarthmore, at least for the present, and hope to learn to adjust and live alone. Just before her stroke, we had planned a trip to see covered bridges in Switzerland and Austria. I asked my daughter, Ruth Millington, and my 22-year-old granddaughter, Ruth Bowie, to take our places. They returned with excellent color slides of 101 covered bridges with interior shots as well as line sketches of all their trusses. With this data, I plan to write a magazine article on European covered bridge construction.

Please try to write, even though you receive no direct request. Belatedly, I wish you all a Merry Christmas and good health during this New Year.—**Ray E. Wilson**, Secretary, 304 Park Ave., Swarthmore, Pa. 19081

13

Well, Happy New Year again. Now that the "landslide" is over, let's get down to business. The Capens were very much honored by short calls from two of our classmates. **Clarence (Jim) Brett** and his attractive wife, Garnet, stopped here in the latter part of August for a few hours

on their way south from a tour in northern Maine. In early October, **Henry (Heinie) Glidden** and his charming wife, Jane, spent a few hours with us on their return trip home following a painting expedition and vacation along the coast of northern Maine. We have been in communication with Albion Davis and Ray Wilson, '12; Parke Appel and Walter Saunders, '22, as well as William Mattson, Charlotte Sage, and Ellis Brewster, '13, besides Fred Lehmann and Richard Knight of the Alumni Office.

The plans for our 60th Reunion are progressing for our "On Campus" at M.I.T. The Capens enjoyed a "Mystery Tour" on October 15, sponsored and directed by the A.A.A. organization and shared with 500 car owners. This tour covered Maine and parts of easterly New Hampshire. We spent six and one half hours and drove about 160 miles. It was delightful, especially the views of the White Mountains and the fall foliage. . . . We are indebted to the Alumni Office for two short notes from two of our classmates. **Vernon G. Kay** writes, "Engaged in part-time consulting in production management." . . . Eva and **Fred Lane** write, "We haven't done much this year, but work around home. As our house is on a half-acre of ground, caring for it is about all we can do. We hope to be in good enough shape to attend our 60th next June."

We expect the Capens will attend the M.I.T. Club of Western Maine fall-dinner meeting, Wednesday, November 15, 1972 at the Holiday Inn, Portland, Maine. . . . **Arthur W. Vose**'s new address is 30 Curtis Rd., Box 109, Milton Village, Mass. We hope to see you in June at our 60th Reunion.—**George Philip Capen**, Secretary and Treasurer, **Rosalind R. Capen**, Assistant Secretary, Granite Point Rd., Biddeford, Maine 04005

14

Herman A. Affel died at the age of 79 on October 13, 1972, after a long illness, but only two days after he entered a hospital near his home in Rome, Maine. He was elected Secretary of our Class at our 50th Reunion in 1964, and met his responsibilities devotedly until his increasingly poor health required him to resign the office in July of 1971. Herman had been Class Agent and Assistant Secretary for a long time before 1964, and had been a member of the Alumni Council until rather recently. He served also as an Honorary Secretary of the Institute, and in that capacity interviewed candidates for admission until only a year or two ago.

Herman was a member of our Class from the beginning, received his degree with us in Course VI, and was a Research Assistant in the M.I.T. Electrical Engineering Department for two years after his graduation. His 42-year career in the Bell System began in the engineering department of American Telephone and Telegraph Co., in New York in 1916. In 1919 he became a member of its development and research department, which was made a part of the Bell Telephone Laboratories in 1934. Herman was appointed Director of Transmission Development at the Laboratories in 1944, Director of Development in 1949, and Assistant Vice President in 1951. His work at the Bell Labs was in communications, particularly high-frequency transmission. His inventions provided systems in which speech volume, or the strength of a radio signal, is kept constant by automatic electronic means, thereby eliminating the need for constant monitoring. He made many contributions to the development of high-frequency transmission systems, multiplex carrier-current communication systems, and long-distance telephone transmission. In 1929, with Lloyd Espenshied, Herman invented the coaxial cable system. He was named as inventor in 123 patents, wrote many technical papers, was a fellow of several engineering and scientific societies, and was a member of the Telephone Pioneers of America. In 1940, he received the Modern Pioneers Award of the American Manufacturers Assoc., and in 1958, received two plaques from the U.S. Army Signal Corps for his support of its research and development program and for his service as a member of the Beacom Mission during the Korean War, and of the Chief Signal Officer's Research and Development Advisory Council. Trips to Alaska, Japan, and Korea were included in the services recognized by those plaques.

For some years after 1916, Herman's home was in Brooklyn, N.Y., where he was born. He later lived in Ridgewood, N.J., for more than 25 years. While there, he was on the boards of the Y.M.C.A. and the Community Chest, and was for several years President of the local Boy Scout Council. In 1945, Herman moved to Summit, N.J., and upon retirement from the Bell Labs in 1958, moved to North Bay Farm, which includes a large tract of land on a lake, in Rome, Maine. Herman became a registered professional engineer in Maine and was active as a consultant in the field in which he had become so well known.

In 1918, Herman married Miss Bertha May Plummer, a sister of Mrs. Mary Plummer Rice, '15. After her death, he married, in 1929, Miss Dorothy Ruth Pape, who survives him. Herman left a son, Herman A., Jr., '41, who lives in Philadelphia; a daughter, Priscilla (Mrs. Thomas G. Weilepp, Jr.), of Houston; and six grandchildren. Flowers were sent in the name of the Class for Herman's funeral, and in a note addressed to "Dear Class of 1914," Dorothy wrote that they had been comforting to her. Several of us have sent her letters of condolence. Her address is R.F.D. 2, Oakland, Maine 04963.—**Charles H. Chatfield**, Secretary, 177 Steele Rd., West Hartford, Ct. 06119

15

The annual trek of the Northern "snow birds" to the alledged sunny Florida spots has begun with **Jack Dalton** to Winter Park, **George Easter** somewhere, **Whit Brown** to Anna Maria, **Boots Malone** to Umatilla, **Larry Landers** to Hollywood, and no doubt several others on their way. And we have to stay here to suffer thru the miserable winter of snow, ice and cold winds.

At lunch at the M.I.T. Faculty Club on October 13 were 17 classmates and guests gathered for another Class luncheon. We greatly missed our good President, Jack Dalton, who was suddenly unable to come on the morning of the meeting. It's a pleasure to record the "long distance" men **Larry Bailey** and **Ray Delano**, South Duxbury; Whit Brown, Concord; John Dalton, Providence; **Ben Neal**, Lockport, N.Y.; **Charlie Norton**, Martha's Vineyard; **Fred Waters**, Marblehead; **Pop Wood**, Peterboro, N.H. We welcomed Ben Neal as the winner from distant Lockport. Also present were **Dinger Doane**, **Clive Lacy**, **Azel Mack**, **Archie Morrison**, **Wally Pike**, Pirate, **Gerry Rooney** and Bill Sheils (a staunch supporter). **Bill Brackett**, unable to come, phoned from South Duxbury.

Notes of regret from those unable to attend attest to their interest—Alton Cook, David Hamburg, Peter Murphy (minding the store for Harry cruising in Bermuda), Evers Burtner, Larry Quirk (in the South Pacific) and Louie Young. All in all, a fine bunch of old friends! The old Pirate, in fine form, started us off with his nostalgic cheer "We are happy." An hour of cocktails and a delicious lunch put us all in a good mood. The success of our noon-time meeting is now well established.

Bert Adams is leaving Brookline to live near his married daughter in Sewickley, Penn. He has donated his valuable and extensive library of books on magic to The Boston Public Library, where it is housed in a special room. Bert used to entertain us at our meetings with some of his tricks. Once, Speed Swift took some close-up movies of Bert performing. When he showed them later, we still could not discern how Bert did it and we were as baffled as ever.

Frank Boynton, writing from L.A. says "To all who remember this old Texas boy, I've just been thru a cataract operation which was no problem, but the convalescence is still going on. I am happy to report it was successful." Good luck, Frank, for a complete recovery. . . . Before leaving for Florida, **George Easter** wrote from Buffalo, "Nothing exciting to report personally but maybe you will find the enclosed photocopy of a clipping about my daughter of some interest. Her married name is Megill and she is Coordinator of Nurses in the University Hospital in Gainesville, Fla., where her hubby is a prof. I never did find out how it happened, but last summer she was one of four or five United States nurses selected to go on a medical visit to Red China where they wandered around widely, met the Minister of Education, and after three weeks there, were tendered a banquet with 22 courses!" . . . **Max Woythaler** spent October on the Florida Gold Coast between Palm Beach and Fort Lauderdale. . . . Good notes this month, eh? But, to keep the column going you'll have to "help Azel." **Azel W. Mack**, Secretary, 100 Memorial Dr. Apt. 2-6A, Cambridge, Mass. 02142

16

And a happy and healthful New Year to

you and yours! Just think, it was 60 years ago when we were half-way through the first year at the Tech on Boylston St. As someone recently wrote, "Time certainly fugits!" . . . On September 21, the American Museum of Immigration was dedicated at the Statue of Liberty N.Y., with the presentation of a medal by the French Consul General, remarks by Pierre S. Dupont, President of the Museum, by Honorable Rogers C. B. Morton, Secretary of the Interior, and by President Nixon. As indicated in the program: "The Museum will become an integral part of the Statue of Liberty National Monument in telling the story of the making of America. The lady rising majestically provided so many immigrants with their first view of America, as a symbol of hope, freedom, and the ideals of liberty." **Walt Binger** has been among the group working on this for 18 years, and is Vice President of the Museum and on the Executive Committee of Trustees.

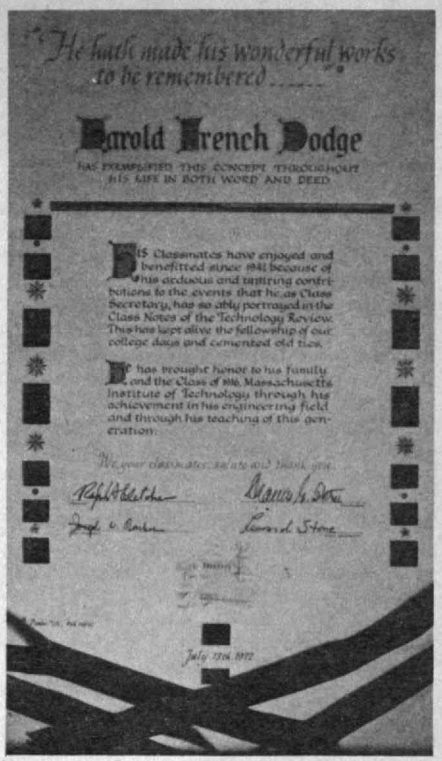
In October, **George Maverick**, writing from Charlottesville, Va., indicated that his and Ruth's Shepherd's Hill Farm, with its 250 acres, and little help to be had, "keeps us both busy. Could say the jungle is closing in on two old people but the fall begins to get so beautiful and the birds are an all-day pleasure. So far this year we've gotton over 600 pounds of food for them." (**John Fairfield**, **John Gore** and **Cy Guething**, please note.) Then: "Our wild turkey and deer are a little late but a neighbor had a black bear on his porch. Our nine grandchildren are so grown up and scattered that they can't visit us as often so we've taken a married student couple in our guest house. They're supposed to watch over and protect us but so far it has been just the opposite." Says he and Ruth hoped to fly to Greece or drive to Texas and Mexico before the snow starts to fly. Sends his regards to the Class and says he "could summarize by saying we are too busy to count our blessings."

Further South in Clearwater, Fla., **Dick Knowland** has no "earthshaking" episodes to write about. But, "as for your complimentary suggestion that I might have a bit of philosophy, I am so dry of such things that I must refer to the poet, Donne, the themes being acceptance of things as they are, and prayer—both of which apply to us elders. We all know 'Send not to inquire for whom the bell tolls, etc.' which covers acceptance. In one of his sermons as respects prayer, he admitted that, even while confessing his sins, he privately knew he would repeat them." Our checking confirms John Donne, 1573-1631, as the most popular english preacher of his day, who at 41 became dean of St. Paul's. . . . Also from Florida, comes word from Alma and **Coke Flanagan** of another happy 50th wedding anniversary in December 1971, reported as "the only one event of recent importance, at least to us." Further, "Our son and family journeyed from Virginia for the occasion and Christmas here in Florida. The champagne was excellent but somehow it has become much more potent than it used to be." . . . From our ever-thoughtful brother-secretary of the Class of 1915, Azel Mack, we received a clipping from the October 6 issue of the *Vineyard Gazette* of Martha's Vineyard with a nice little item on "**Izzy Richmond** Is Still an Active Pilot." Izzy had flown down to the island in a Cherokee "just for the day to paint a picture of James Reston's Edgartown house, which I saw on my last visit and liked."

Frances and **Paul Duff** tell of the wedding of their youngest son, Brendan, and a wonderful trip to California and added, "Only 22 of us went!" Who else could say "only 22?" Frances has always said she would wait for the wedding of their youngest to have her first glass of champagne. Now, when asked about this, she says she didn't get the champagne for someone filled her glass with punch, and now she'll have to wait for their 50th wedding party. . . . The Duffs report enjoying a visit with **Earle Townsend** who was recovering from a broken hip and was much interested in hearing about the doings at the Reunion. . . . **Lev Lawrason** in Leisure World, Seal Beach, Calif., says things move on well and "we just get a little older." As for the much younger generation, "My youngest grandson has become very interested in mountain climbing and has spent most of the summer in the high altitudes. His roommate's family has a home near Bishop (on the East side of the Sierras) and they use this as a base camp. A few months ago, enjoyed seeing **Ken Sully** of Laguna Hills Leisure World." . . . We've had word from Sylvia and **Vertrees Young** of Bogalusa, La., who, in September, entertained President Lockwood of Trinity College, Hartford, Conn., with a small assemblage of 28 or 30 in his honor. Vertrees also says "Despite a summer of pain and adversity, the Youngs, in the indomitable spirit of the class of 1916," declare that things look brighter ahead. . . . In September too, word from **Henry Shepard** noted that Frances and he spent another most enjoyable summer in their cottage in Randolph, N.H. Frances did a lot of hiking and Henry split one and a half cords of wood to get himself in shape for winter's bowling and curling.

Dick Hunneman of Wellesley Hills expresses hope of attending one of our annual reunions soon but "early June presents conflicts: Mother's birthday (she recently died at 102), and West Point Parade and reunion of small World War I group who fought in Argonne in 1918 when I stopped a German bullet." Speaking of his children, he adds, "Son Dick, with G.E., flew to Japan twice on power plant business; son Conrad, chairman of Harvard class reunion committee; son-in-law Elliott Cutting, space scientist in Pasadena has two fine children." . . . Our ever-amazing traveler **Phil Baker** says that "without rhyme or reason" he "took off for Paris and Vienna about the middle of June. Paris is such a tremendous and beautiful city, but its traffic is worse than ever. I was impressed with the automatic speaker on the city sightseeing bus that turned on and off with the traffic. I went on to Vienna, which proved to be delightful as always; heard the opera *Don Carlos* while there."

The **Theron Curtis**es of Barrington, R.I., tell of their busy summer of a kind that somehow we all now seem to appreciate so well, "With both of my sons now living on the Cape, we have most of our seven grandchildren with us a lot. All of which is wonderful but you doubtless know how the old nerves act at times." As to what he's doing, "Mowing grass and working on the place or sitting down to rest." His bit of philosophy, "Vote for Nixon." **Howard Evans** reports from Lincolnville, Maine: "No activities other then minor diversions. Quiet, comfortable, care-free retirement with hobbies, friends; and grown-up children doing all right, grandchildren all OK." . . . **Art Caldwell** says all goes well in Meadow Lakes Village in Hightstown, N.J.



An illuminated scroll presented by the Class of 1916 to Harold F. Dodge in appreciation for his untiring contributions as Class Secretary.

Len Stone submits the following for this month's column: In the October-November Notes the presentation of an illuminated scroll to **Harold Dodge,** as instructed by the Class at the '72 Reunion, was noted. Now that all signatures have been obtained, the Scroll has been photographed and is illustrated above. Five by seven inch color prints large enough to read the words are available from our Treasurer, **Francis Stern**, who was deputised to express the sentiments of the Class and have them incorporated in a suitable scroll. His address is 45 Beverly Rd., West Hartford, Conn. 06119 The price is whatever you think the prints should cost but if the spirit moves, a generous overpayment will be appreciated to change the color of the balance in the treasury (from red to black). The Scroll reads as follows: "He hath made his wonderful works to be remembered." Harold French Dodge has exemplified this concept throughout his life in word and deed. His classmates have enjoyed

and benefitted since 1941 because of his arduous and untiring contributions to the events that he as Class Secretary has so ably portrayed in the Class Notes of the *Technology Review.* This has kept alive the fellowship of our college days and cemented old ties. He has brought honor to his family and the Class of 1916, M.I.T. through his achievement in his engineering field, and through his teaching of this generation. We, your classmates, salute and thank you: **Ralph A. Fletcher**, President, **Joseph W. Barker**, Vice President, **Francis E. Stern**, Treasurer, **Leonard Stone**, Assistant Secretary.

Once again, don't wait for any special invitation. Just write your willing-to-work Secretaries on even the slightest provocation. A bit of philosophy is always most welcome so send along any that you think we might use—**Harold F. Dodge**, Secretary, 96 Briarcliff Rd., Mtn. Lakes, N.J. 07046: and **Leonard Stone**, Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y. 11372

17

Over the years, all of us have been aware of the Honorary Secretary program which is now the Educational Council. What most of us have not known is the splendid work our classmates did in that interviewing, recommending-of-prospective-students program and who they were. Of the 12, four are no longer with us, though they are listed. None are now active but a big thank-you is extended. They are **Rad Stevens**, Ted Stahl, Charlie Ellis, **Al Litchfield**, **Ray Brooks**, Frank Maguire, Win McNiell, Francis Thomas, **Dick Lyons**, **Dick Catlett**, **Phil Cristal**, **Bill Sullivan**.

The Class of 1918 kindly invited members of 1917 to join them on a one-day Reunion on October 22 at Endicott House along with others of 1919. It was a very pleasant gathering and your attention is called to the following Class of 1918 notes regarding it. Our '17 representatives were the Lunns, Ray Stevenses, Dunhams, Dunnings and **Jim Flaherty**.

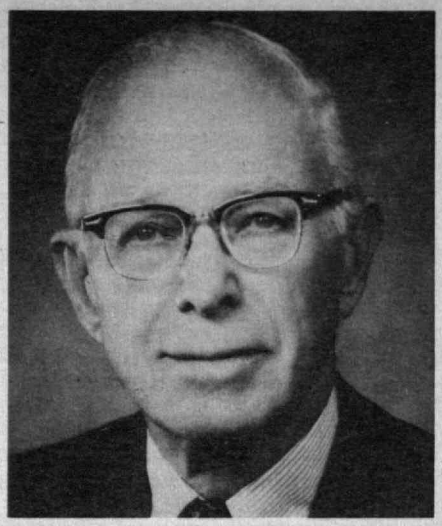
Ray Ramsey and Betty had a "marvelous trip" as the "only senior students" on the recent "World Campus Afloat," visiting Africa and the Orient. . . . **Dave Waite** has a new great-grandson. . . . **Warren Tapley** continues to improve from his coronary. . . . **Ed Aldrin** was a speaker at the 40th Anniversary Meeting of the founding of the American Institute of Aeronautics and Astronautics in New York on October 5. A U.P.I. release from Paris reads: "A group of 43 American World War I pilots leaned on canes, saluted, and stood at attention as their leaders placed a wreath at the foot of the *Arc de Triomphe.*" These flyers were members of the aviation section of the Army Signal Corps and were flying under Billy Mitchell when he was starting to think of making an air force, the release quoted Ray Brooks as having said. The group received the red carpet treatment on all occasions.

Word is received of the death of four of our classmates. **Howard Littlefield** died in Studio City, Calif., on June 7, and **Carleton C. Adams** died in Providence on September 7. . . . **Alfred Pierce** died in Long Branch, Calif., on August 25. In 1965 he wrote to M.I.T. that he would like to make a gift and asked for procedural information. Since that time he has been a substantial giver every year to the Alumni Fund. He was in various engineering activities at home and in the Orient, covering ship building, municipal engineering, irrigation, Federal and County works, schools and airports. . . . **Paul Gardner** died in San Patricio, New Mexico, on September 11. He had majored in museum administration, art history, and architecture. In 1932, he was engaged to take part in the creation of a major art gallery, the Nelson Gallery at Kansas City. As this developed, he became its first director. With time out for World War II, he continued as Director until his retirement in 1953. He was credited with many innovative features for museums. . . . Equestrian **Enos Curtin** had bad luck recently when riding out on Long Island. Out of tall grass a pheasant rose into his horse's face, causing the horse and Enos to go in opposite directions. Enos has now recovered pretty well from a damaged back. . . . Classmates **Neuberg**, **Seely** and **Loengard** attended the '16-'17 luncheon on November 9. The next one is on December 7 at the Chemists Club. —**Stanley C. Dunning**, Secretary, 6 Jason St., Arlington, Mass. 02174; **Richard O. Loengard**, Assistant Secretary, 21 East 87th St., New York, N.Y. 10018

18

On October 22, the first joint meeting of the Classes of '17, '18 and '19 took place at Endicott House, Dedham, Mass. The group numbered about 60, of whom nine were guests from the M.I.T. Administration. Eighteener's included: Mr. Julian M. Avery; the Eli Bermans; the Samuel V. Chamberlains; the Saxton W. Fletchers; the Clarence Fullers; the Alfred P. Grossmans; the Edwin R. Harralls; the Julian C. Howes; the John T. Kileys; the John W. Kilduffs; the Herbert L. McNarys; the Max Seltzers; the Charles H. Taveners and the Charles H. Watts.

The Program started with a sherry hour, luncheon, picture taking, and inspection of the grounds at Endicott House. We were then privileged to hear Chancellor Paul Gray. He told us of the problems facing privately and publicly supported colleges. The actual cost for a student in either location is about the same ($5,000 to $6,000 per year). The tuition for the State College is about $500, with the Commonwealth paying the balance. At M.I.T., the student is billed about $3,000 with Alumni support, endowments and generous benefactors supplying the difference. Maintaining first-rate quality commands high priority, especially while state supported colleges are increasing teachers' salaries ten per cent per annum compared to M.I.T.'s three per cent. Another problem facing all universities is the large number of high school students, amounting to 50 per cent, choosing to go to college. Can U.S. industry absorb this number of graduates or should we emulate Great Britain where some of these applicants for higher education are encouraged to go to trade school?



Craig P. Hazelet, '18.

Dr. Gray then introduced Professor Margaret MacVicar, who described U.R.O.P. (Undergraduate Research Opportunities Program.) Over 1000 undergraduates are involved in research under the direction of a Faculty Advisor in a wide range of disciplines and independent student activities, often outside the classroom. It is an exciting new approach to teaching—it heralds a revolution in the method of instruction—all of which should be most stimulating to an eager young mind.

The afternoon concluded with a relaxing cocktail hour. **Sax Fletcher** went to his car but found his keys locked inside. Fred Lehmann saved the day with a coat hanger opening of the front door. **Pete Harrall** misplaced his glasses and stood up to ask if anyone had found them at luncheon. Was he surprised when Frances Harrall announced she had picked them up and placed them in the security of her pocketbook! Question:—did it teach Pete a lesson? Reluctantly, we went our various ways—enthused—and looking forward to a repeate performance next fall.

We are happy to learn of the highest honor given **Craig Hazelet** by the American Society of Civil Engineers as noted by their news release, "Craig P. Hazelet of Louisville, Ky., today received Honorary Membership in the American Society of Civil Engineers. He received the Society's highest honor at the Annual National Environmental Engineering Meeting in Houston. Notable as a bridge designer, Mr. Hazelet is a consultant to the Louisville firm of Hazelet and Erdal, of which he was co-founder in 1936. The firm specializes in fixed and movable bridges, grade separations, and super highways. Prior to opening his own firm, Mr. Hazelet was President of the Sherzer Rolling Lift Co., Chicago. He was earlier an Associate in the Civil Engineering Department at the University of Illinois and did graduate work at M.I.T. He has also been active in A.S.C.E. affairs. He is a former director and served on many national committees of the Society. Mr.

Hazelet was named Louisville Man of the Year in 1962. His firm has also received numerous bridge design awards from the American Institute of Civil Engineers. In June, he received an honorary Doctor of Science degree from the University of Louisville."

We print herewith a comment from **Stuart Elliott**, "Am interested in observing horse racing, baseball and politics. The first two make sense as class generally pays off. As for politics and government, they somehow get you there but no better than an old Model T Ford, all tied together with hay wire, so often encountered in the '20s. However, I was born a Republican and remain one." . . . **Tom Brosnahan** is about to publish his book, *All Over the World* covering 18 vacation trips. The Brosnahans expect to be in Austria for the ski season in February. . . . George Sackett has moved to 170 Highland St., No. 208, Tauton, Mass. 02780.

Keep the news coming!—**Max Seltzer**, Secretary, 60 Longwood Ave., Brookline, Mass. 02146

19

The M.I.T. Alumni Association informed us of the passing of **Edgar F. Seifert** on September 28, 1972 in Valparaiso, Ind. Word was also received from Phil Coleman, a long-time friend of Dutch's and from Edmund J. Flynn. Dutch was ill for a few months, but surgery for cancer of the lung was unsuccessful. He was founder of the American Chemical Service Co., from which he retired as President a few years ago. He was a past president of the M.I.T. Club of Chicago and was responsible for many youngsters from northern Indiana going to M.I.T. He did this as an Educational Counselor. He was a cellist in the Gary Symphony Orchestra and a member of its governing board.

Doc Flynn and his wife Erma were at M.I.T. on Alumni Day and were joined for lunch by **Roy Burbank**. Doc is serving his last year as M.I.T. Educational Counselor. He has been Executive Secretary for the Palmerton, Pa., hospital and has just concluded a very successful drive for funds with a big activity in the local park with many local organizations participating. He has also been active as Leadership Development Committee Chairman of the Pocono Boy Scout District. Doc went up to see **George McCarten** in N.H. in June and reports George is a cancer victim but doing remarkably well.

We had word from **Jim Reis** from Los Angeles, Calif. He is still traveling and spent two months in Indonesia, mostly in Sumatra, Java, Bali and North Borneo. . . . Word from Reverend John S. O'Conor, '36, Chairman of the Department of Physics at St. Joseph's College, Philadelphia, Pa., that **Harry A. Kuljian** and Andrew W. Kramer have authored a book, *Energy Through Nuclear Reactors* published by St. Joseph's College Press and sponsored by the Physics Department. According to Father O'Conor "It is a reference and source book for the general student, educated layman, and scientists in fields other than physics or engineering who are interested in learning about atomic energy."—**E. R. Smoley**, Secretary, 50 East Rd., Delray Beach, Fla. 33444

20

In the October/November issue, these notes reported the appointment of **Lauren Hitchcock** as Director of Ecology and Environment, Inc., a Buffalo consulting group joined by Lauren after nine years at the State University of New York at Buffalo. I now have the sad duty of reporting his death in Dorset, Ontario, where he and his son were closing his summer cottage. Lauren was born in Paris and grew up in Belmont, Mass. After graduating with our Class, he earned a Master's Degree and Doctorate in science at the Institute, taught chemical engineering at the University of Virginia for several years, and became a successful executive of Houlser Electro-Chemical Co., Quaker Oats Co., of Chicago, and National Dairy Products Corp. He was a founder and past President of the Commercial Chemical Development Assoc. An early leader in the fight against air pollution, he was named President of the Air Pollution Foundation of Los Angeles, formed to combat the smog problem there. More than 10,000 tests were undertaken by the foundation to help determine the process by which pollutants become smog by chemical action in the air. At one time he served as Chairman of the American Section of the Society of the Chemical Industry. He leaves three daughters and 13 grandchildren to whom the Class extends its deepest sympathy.

Members of the Class will be happy to know that **Harold Bennet** is recovering from a recent illness and is keeping busy with genealogy and archaelogical displays for the local M.I.T. group at Denver, Colo.; address 5072 Tenneyson St. . . . Count one more among the many classmates that have left New England to seek a sunnier clime. **Henri S. Lench**, formerly of Lexington, may now be found at 442 James, Dunedin, Fla.—**Harold Bugbee**, Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

Happy New Year! May 1973 bring us together in Florida, Mexico City, or perhaps Cambridge next June!

A letter to the *New York Times* in September from **John W. Barriger**, President of the Boston and Maine R.R., commented on previous letters urging a merger, first of Northern New England railroads, to be followed ultimately by a unified national railroad system, privately owned and operated. John urged a complete New England system first as "the best way to achieve the larger objective."

Our Class Estate Secretary, **Edmund G. Farrand** of La Jolla Calif., replied to a recent letter from your scribe and told how he missed seeing other classmates. "I miss the Georgia plantation and the great people of the Old South, but there is no better place in the country for Helen and me than right here. For physical reasons, we stay at home. Helen's rose garden is always in full bloom and I look out on poinsettias eight feet tall." Ed described how before entering M.I.T., he studied violin with the Assistant Concertmaster of the Boston Symphony for three years, then realized he was no musical genius and went to Tech. He and Class Agent **Edouard Dubé** continue to work valiantly on behalf of M.I.T.

Assistant Secretary **Josh Crosby** reported that last June he talked briefly to **George Chutter** and had a short visit with Millie and **Don McGuire** on Cape Cod. The McGuires told of visiting **Ivan Chambers** in Charlotte, N.C., last winter and said Ivan keeps busy with his landscaping problems. The Crosbys reported a cool but pleasant summer in Brooklin, Maine.

Laurence O. Buckner of York, Pa., is busy assembling a collage of slides of classmates, mainly snapped by him at our 50th Reunion. The film is removed from the cardboard mounts and then "those damn little things jump around like a bunch of puppies." The finished collage will be turned over to **Robert F. Miller**, our class photographer, and he in turn will take orders for large prints. Cost—$2.50 to $4 per print, depending on number of orders received. . . . Buck tells of teaching "Electricity" and "Electrical Machinery" at Penn State Extension College for about four years after he first retired. This was a part-time job and during the period, "Mary and I travelled to Holiday Inns in all but one of the states. Now on TV travelogs, hardly an evening goes by that we can't chuckle and say 'we've been there.'" Following his teaching, Buck had various consulting jobs on heavy plant wiring and special equipment selection. Last winter, McCrory, McLlellan, and Green Stores hired him for advisory work on all their utilities in 600 stores in 37 states, "the easiest part-time job I've ever had."

An early October snowstorm marked the start for your Secretary of a most enjoyable week's trip to Cape Cod and back. Bob Miller made a luncheon reservation in Orleans for eight of us, including his wife Helen, Millie and Don McGuire, Hazel and **Whitney Wetherell**, and Betty and **Sumner Hayward**. The McGuires told of their recent trip into New Hampshire and Vermont to glory in the fall foliage. Their son is currently engaged in a study of the possibilities of installing a 200-inch telescope in an orbiting space station. After lunch, the group made a round of the Cape Codder's homes. Don McGuire showed various tables, cabinets, and even a grandfather's clock he had made for his home in East Brewster. These are beautifully finished pieces that well display his craftsmanship. Both Don and Bob Miller sat down at the McGuires' organ and entertained the group with familiar songs of college days. The Miller's cottage in West Chatham was in the process of being closed but it still showed its charm and the fine view of the harbor. Bob told of a recent visit he made to Chappaquiddick Island to case the joint. Ask him about it. The Millers were planning another Caribbean cruise in December. Hazel Wetherell showed her artistic talent in a number of

paintings adorning the walls of their home in Harwich. Both of the Wetherells are involved in church work—he as chairman of the board of religious education and she as church librarian. . . . The day following the luncheon in Orleans included a brief call on the **Austin Kirkpatrick**'s in Hyannis. Your Secretary had last seen Kirk in 1921 as a fellow resident of Runkle Hall at M.I.T. Their daughter just graduated from Wheaton and is now teaching in Brockton, Mass. Kirk works in Hyannis and is in the ideal situation of being within easy walking distance of both his office and the shopping center. It was good to renew acquaintances again.

The Haywards were entertained overnight at Emma and **Al Lloyd**'s in Westerly, R.I. with an afternoon ride around Watch Hill and Misquamicut. . . . The final stop on the Cape Cod journey was lunching at Helen St. Laurent's in Manchester, Conn. Helen served a delicious seafood Newburg including lobster brought back from Maine. She reported a good summer at Vinalhaven. A clipping which she furnished your Secretary from the *Manchester Evening Herald* of October 10, 1972, told of a proposed Silverstein youth center to be constructed on the grounds of Temple Beth Shalom as a "living memorial" to the late **Saul Silverstein**. Saul was a founder and the first president of his temple.

As these notes are being written on the day after Election, the annual trek to Florida has already begun. A note from **George Schnitzler** advised that he and Anne will be at 1076 Venetian Way, Miami, Fla. 33139 for the winter. He asked to be counted in if the Class has an interim reunion in Florida in March. The Schnitzlers recently returned from a 30-day tour of Israel and Europe. . . . **Phil Coffin** is now at 1950 Gulf Shore Blvd., Naples, Fla. 33940. Also, **Morris B. Hart** is at 4001 South Ocean Dr., Hollywood, Fla. 33020. By January there will be lots more.

It is our sad duty to report the death on October 22, 1972, of **Dr. Frederick W. Adams** of Clarendon Hills, Ill. A note from Mrs. Adams enclosed the obituary published in the *Chicago Tribune*. Fred had been in a nursing home following surgery in June, 1969 and August 1971. Mrs. Adams wrote a very warm letter a year ago about Fred and his three fine sons. The Class extends its deep sympathy to the family.

Class president **Irving Jakobson** wrote that he and Ruth have sent in reservations for the 25th Fiesta in Mexico. Several others have indicated their plans to go.

Address changes: Dr. Thomas P. Campbell, P.O. Box 2040, Denver, Colo. 80201; Kenneth V. Hill, Rt. 1, Scudder Lane, Box 123, West Barnstable, Mass. 02668 (George Chutter take note); Frederick F. Olson, 2030 Carquinex, El Cerrito, Calif. 94530.—**Sumner Hayward**, Secretary, 224 Richards Rd., Ridgewood, N.Y. 07450; **Josiah D. Crosby**, Assistant Secretary for Florida, 3310 Sheffield Cir., Sarasota, Fla., 33580; **Samuel E. Lunden**, Assistant Secretary for California, Lunden and Johnson, 453 South Spring St., Los Angeles, Calif. 90013

22

Wouldn't you know that **Parke Appel** would start the year with a glowing message about our Class of 1922? We are impressed by the "grand total of $2,781,000 in cash gifts since our origin as a Class". Our gift at the 40th Reunion was just tremendous and our 50th combination was colossal! We're all back of Class Agent **Dale Spoor** in his efforts to collect your continued cash support. . . . Your Secretary hopes to join other officers in Florida about February 1 to plan another "happening" in Boston. We may have snow in Buffalo by that time. By the way, we wandered through the halls of M.I.T. during late October to be besieged by leaflets and opportunities to join various organizations. We felt that the student casual attire was slightly more conservative than was in evidence during our June Reunion.

Many Class members find that they can't resist an active life during retirement. **Ray C. Burrus** has been elected Treasurer of the Board of Directors of the Broward County Area Planning Board. Their circular indicates a most constructive attitude for better living for 1,230,000 people. . . . The big and boastful news is about **Hugh Shirey**, our famous golfer from the Country Club of Rochester, N.Y. He is admired as a 74-year-old golfer who shot a 75 while still holding a 10 handicap. He took a 40 on the front side but finished with an even par 35 having bogies on the last two holes. He modestly reports "I just use the correct clubs and swing them properly." Barb and Hugh send regards to all as they think of our wonderful Reunion in June. . . . **Dwight F. Johns** and Mrs. Johns visited their great granddaughter and her parents at Karlsruhe, Germany, on her first birthday last May. They rode the *Queen Elizabeth II* to Cherbourg "along with the alleged bombs."

The sympathy of our class is extended to the family of **George A. Noveck** of Trenton, N.J., as he passed away in September. He served for many years as a civil engineer and bridge designer with the U.S. Department of Public Works.

Among the changes of address reported are: Charles T. McGrady, El Paso, Tex.; Aubrey K. Nicholson, Jensen Beach, Fla.; Edward J. O'Connor, Nashua, N.H.; William D. Pinkham, Granbury, Texas; Arthur F. Rogers, Hollywood, Fla.; Elmer E. Sanborn, Atlanta, Ga.; Manuel Shampanier, Coral Gables, Fla.; Roland L. Smith, DelRay Beach, Fla.; John B. Starkweather, Venice, Fla.; C. Willis Stose, Daytona Beach, Fla.; Howard B. Upham, Cullowhee, N.C.; Bartow Van Ness, Jr., Baltimore, Md.; Parke D. Appel, Venice, Fla.; Reginald S. Hall, Tryon, N.C.; Oscar H. Horovitz, Pompano Beach, Fla.; Broderick Haskell, New York, N.Y.; Harold E. MacDonald, Wilmette, Ill.; Mrs. Paul Ryan, Larchmont, N.Y.; Harvey L. Williams, Key Largo, Fla.; and Samuel I. Zack, Harrisburg, Pa.

A happy and healthful season to you vacationers and retirees in the South. Have fun in the sun!—**Whitworth Ferguson**, Secretary, 333 Ellicott St., Buffalo, N.Y. 14203; **Oscar Horovitz**, Assistant Secretary, 3001 South Course Dr., Pompano Beach, Fla. 33060

23

The class notes and news items are again extremely skimpy. I guess we all must be holding everything off until our 50th Reunion. Don't forget the dates: May 30 through June 4, 1973.

Forrest F. Lange has sent us a copy of a circular letter sent out to members of the Northern New England Section of the American Society of Mechanical Engineers under the heading "Historical Challenge." It seems that the National History and Heritage Committee of that august society is searching out and making an inventory of mechanical things and places that have historical value and interest. This includes such objects as antique engines, pumps, water wheels, etc. In his usual thorough way, Forrest tells each and every member of that section of the A.S.M.E. what to look for, what to record, and what equipment to take on a purposeful safari of this type. If interested, communicate with Forrest at 1196 Woodbury Ave., Portsmouth, N.H., 03801.

Alan R. Allen writes us of his personal achievements in conquering his "crippling attacks of arthritis." Al goes on to describe a cure of other ailments through dosages of "some rather special garden vegetables." So if you need a do-it-yourself regimen of cure for you-know-what, I know Al will be glad to suggest if not prescribe. Al seems to flourish well at 525 Lexington Ave., New York, N.Y., 10017. Perhaps there is something of value in that horribly polluted New York air of which we know so little. Congratulations Al, we look forward to hearing it firsthand next May-June.

Joseph H. Cox reports that he is retired and enjoying the delights of Northern California. . . . **Charles E. Roche** tells us of his recent visit to see his daughter in San Diego and a very pleasant talk with "**Cecil Green**, our sterling classmate!" . . . **Herman B. Swett** also sings the praises and delights of the California climate where he plays golf and swims daily with his wife, Evelyn. . . . Finally, a note of sadness concerning the recent death of **Raymond P. Harold** of Worcester, Mass., October 10, 1972.—**Thomas E. Rounds**, Secretary-Treasurer, 4 Deer Hill Dr., Danbury, Ct., 06810

24

I sit at my electric word machine, on November 15, with the thermometer at 20 degrees F. in Brookline and our first snow of two inches evaporating, envious of Floridians and Arizonians. When many of you read this, you will feel likewise.

Willard Blaisdell, President of States Electronics Corp., Bludworth Marine Div., writes of his activities. He purchased the company in 1960 and built a new factory in Linden, N.J. It is a closed, family-owned corp., engaged in marine precision equipment used mostly in hydrographic surveys that make "safer sailing with superior electronics and ser-

Michel Froidevaux, S.M.'72, receives the Allen Kochen-Koppen Award, established in recognition of 50 years of glider flight at M.I.T., from Otto Koppen, '24, a member of the three-man M.I.T. team which competed in a glider meet at Clermont-Ferrand, France, in 1922. The award is to given annually to the outstanding student member of the M.I.T. Soaring Association. Looking on with approval is Ernst Steinhoff (center), through whose efforts the association was reactivated in 1969.

vice." The late **Oscar Keefe** and Bill were roommates at G.E. in Lynn. Bill and Hazel have nine grandchildren. . . . **Clarke Williams**, B. A., Williams, '22 was with us for two years. Later he received a Ph.D. from Columbia, '35, and then did research and development on U 235 isotope separation and reactor design at Brookhaven and Los Alamos Laboratories. At present, he is working on Marine Resources with Nassau Suffolk Regional Planning Board. He also serves as a member of the A.E.C.'s hearing board for nuclear power plant licensing.

Bill Correale, Professor at Polytechnic Institute of Brooklyn, has received a commendation from New York City Deputy Mayor Costello for his assistance on the task force of city officials who drafted the report of the advisory committee on fire safety in high-rise buildings. . . . Our perennial headliner, **Luis A. Ferré**, Governor of Puerto Rico, has appeared as a recipient of a Transportation grant for the Commonwealth's Metropolitan Bus Authority, during a special ceremony in Washington. Secretary Volpe presented the grant, which with local matching funds from Puerto Rico will buy 248 Environmental Improvement package kits and 272 L.S.N. fuel injectors for the island's 500 buses. . . . **Chile Serrano**, **Charlie Blake** and Luis were the power of our 1924 fencing team. Belatedly, we learn that he headed a royal sendoff of the Puerto Rican Olympic team, including two fencers, one of whom was Roberto Levis, '64, son of Luis' team mate, and former six-time U.S. epée champion, Joseph Levis, '26.

A note from Jane F. Benjamin, wife of **Berton Benjamin**, tells us that he passed away on April 27, 1972. The last we knew, Bert was President of the Fairfield Oxygen and Ambulance Sevice, Stamford, Conn. We extend our sympathy to his loved ones.

Blanchard (Nickey) Warren sends word from Portland, Ore., "My wife and I had a wonderful cruise through the Canal and Caribbean Sea. Will be at Oakwood, Coronado, Calif., for January and February." . . . **Paul Cardinal** and Lorene took off from Miami on November 3 and returned to Naples, Fla., November 24. This time it was Houston, Honolulu, San Francisco, San Diego and Naples in time for a cocktail party. Paul has suggested the remote possibility of combining the Second Florida Fiesta with the gala Mexico City 25th Anniversary Fiesta, March 15-17. Send your pros and cons to Paul, 707 Port Side Dr., Naples, Fla. 33940.

An appeal letter from **Frank Shaw**, our dedicated Class Agent, has just reached my desk. He suggests six pregnant ways to mollify the gestation period of our 50th Reunion Gift, all of which are innocuous. Try it, you'll like it!—**Russell W. Ambach**, Secretary, 135 Aspinwall Ave., Brookline, Mass. 02146

25

A letter from **Henry Sachs** of New York consists of an updating of his travels. In late 1971 during the holiday season, he visited Mexico and shortly thereafter he flew to Yucatan to visit ruins and native villages. In the spring he went to Israel. He had been stationed there 30 years before as the first U.S. Army officer in charge of logistics. This time he visited Sharm-el-sheik and the Golan Heights, from there to Russian Turkistan and then to Moscow, Leningrad, and Novgarod where food was awful. For better food perhaps, he planned to be in France in November for a meeting of a gourmet society of which he is an officer. Future plans include a conference on social work education and then around the world again. He finally notes that he expects to make the long (?) journey to Cambridge for the 50th. I hope that many others have the same thoughts.

Cliff Abrahamson writes from Cape Cod, where he has been in retirement for the past eight years. He has no regrets for choosing Cape Cod. . . . He notes a visit from **Ed Stavert** this past summer. . . . **Doc Foster**'s letter about the Class Gift inspired **Gilbert L. Delugach** to write. He still lives in Memphis and calls himself semiretired as he has a nephew running his real estate business. He has been active on the Education Council and quite a few local high school graduates have been accepted at M.I.T. with good results. He and his wife, Gertrude, travel quite a bit and play a little golf and bridge. He also plans to be with us for the 50th. . . . **Roger Ward** of Merritt Island, Fla., in a letter to **Chink Drew** records a recent trip to the Orient. He was impressed by Singapore, and what he calls its benevolent dictatorship. In Hong Kong, he had dinner with **Peter Si**, who is a partner in a law firm there. Peter has a daughter in the States and plans to be back for the Reunion. Roger is well and hopes to be with us in 1975. . . . After such interesting information from Henry, Cleff and Roger let's see if more of you can provide choice tid bits for your secretary.

I had reported the passing of **Ralph O. Ballentine** of Rochester, N.H., in a recent issue but was not sure of the date. I can now report that it occured on April 2, 1972.—**E. Willard (Will) Gardiner**, Secretary, 53 Foster St. Cambridge, Mass.

26

These January notes are being put together on a Sunday morning ten days before Thanksgiving. Our summer tenants have moved out of the tiny guest house (the Fo'castle) so I have holed in with a block of paper. It's a delightfully quiet spot to write. Even the telephone has been disconnected for the winter. The sea is continually murmering down below but that's a tranquilizer, not a noise. After all that explanation, I'll do well to keep from nodding off as I write. But a picture of Bob Morrissey atop a clipping from the *Bridgeport Post* attracts our attention and we quote, "**Robert B. Morrissey**, Professor of Physics and Mathematics at Sacred Heart University, was elected to the Presidency of the Institution's University Senate. Professor Morrissey received his undergraduate and graduate degrees from M.I.T., where he was also a physics faculty member for five years. He also taught physics at Columbia University and the University of the City of New York.

"A resident of Greenwich, Professor Morrissey is active in his community as a member of the personnel committee of the Greenwich Regional Catholic schools and as a lector at St. Mary's church, Greenwich." . . . **Carl Nelson** is now living in Laguna Hills, Calif., having retired from the Space Division of North American Rockwell Corp., where he was a specialist in spacecraft electricity. Prior to retirement, Carl received citations from N.A.S.A. and from President Nixon. . . . A news release about a classmate with two thirds of his name identical with that of your Class Secretary brings back old memories. **George Warren Bates** has always been a musician and 50 years

ago he played piano accompaniment for George Warren Smith, violinist with the M.I.T. musical clubs. We quote, "Cohasset's Second Congregational Church will mark the close of a record of church musical service by a single family at a reception on October 15, honoring George Bates who has just retired as Music Director-Organist. For the last 50 years, Mr. Bates has been at the console of the church organ for Sunday services, church school, and choir rehearsals for the past 25 years. His father was an integral part of the church's musical program for 67 years before his death in 1962. "It has been a long time and things have changed a great deal, but I've been very fortunate; I've never missed a Sunday because of sickness and I've always had an awfully loyal group in the choir over the years," says the still youthful-looking Warren, who is finally giving up the obligations he has fulfilled faithfully since 1922.

After revealing that much about my past, let me tell one on Class President **Dave Shepard**. You connect him with Ray Mancha and their banjos but my first contact with Dave was standing in line with him to register for the Musical Clubs where he had his instrument under his arm. We never saw it out of the case so cannot state with authority whether it was a piccolo, flute or clarinet but it got him into the club. The banjo kept him there however.

I find the quiet of Forecastle disturbed by the metal baseboard heat clicking with sufficient decibels to have taken care of any possible dozing of your secretary.

We have just received notices of the deaths of six classmates. **Phil Richardson**, we reported last month. The others are **William W. Hicks** of Marlow, Ok. . . . **Donald G. Welch** of Kenmore, N.Y. . . . **Allan W. Lundstrum** of Columbus, Ohio, **Harold Fox** of Framingham, Mass., and **Duncan A. Crawford** who had recently retired to Buzzards Bay, Mass. Sincere sympathy is extended to the families of these classmates.

We note that **Harvey Abbott** is now living in Cape Neddick, Maine and **Ted Larratt** is in South Paris, Maine. . . . **Giles Hoppie Hopkins**, who has not been as communicative as a few years back, is still at the New York Athletic Club and we assume still a bachelor. We have some of those nice notes that you write in on the back of envelopes that we are saving for another issue and urge you to keep them coming—on the back of an envelope, a post card or if it's more convenient, why not give me a ring any evening at 617-546-3122. May 1973 be your finest year! Cheerio until February. —**George Warren Smith**, Secretary, P.O. Box 506, Pigeon Cove, Mass. 01966

27

Charlie Tedford has had an attack of nostalgia as a result of the recent 45th Reunion. I am going to give a good part of this month's notes to sharing with you his recollections of our undergraduate days.

Charlie says: "Some of my memories of the 'stute: Professer 'Beaker Joe' Phelan and his "stirring rod' . . . Professor 'Pop' Franklin and his annual weighing of the earth in 10-250 . . . Drilling in 'my dinky uniform' on the wind-swept space between Walker and Building 2 (try to find the space today) . . . Coach Frank Kanaly and the cinder and board track practices . . . Bannon and baseball on the diamonds in the then wide-open spaces . . . Professor Douglass squelching a class 'wise guy' with his blackboard demonstration of the difference between zero and nothing . . . Wallie Ross and the T.C.A. . . . the daily hikes between the North Station and the 'stute, and return . . . Using the plotting table and theodolite to map to scale the M.I.T. area, buildings, etc. and to measure the distance between the domes of the Capitol and the Christian Science Church across the river . . . The xylophone effect of Harvard Bridge before it was paved . . ."

Charlie spent a decade with W. T. Grant Co. and nearly a quarter of a century with Ben Franklin Stores, where he was Manager of the 17 Eastern states operations until he retired seven or eight years ago. He also spent four years on active duty with the army in World War II and retired as a Lieutenant Colonel.

Hilda Young writes from her new address in Gambier, Oh., that she is converting an ex-fraternity lodge to be her home. . . . **Lee (Leroy) Miller** has a 50-acre tree farm 40 miles south of Columbus, Oh., overlooking a three-acre lake. He grows Christmas trees for sale to families who do their own woodchopping. . . . **Nat Cohn**, though retired, is still much sought after as a speaker on his specialty of power instrumentation. He spoke on October 12 at the 27th annual I.S.A. Conference in New York on "Control and the Electric Power Crisis," dealing with the technology of reducing the hazards of blackouts. . . . **Edward D. Stone** has been appointed Adjunct Professor of Landscape Architecture at the University of Miami School of Engineering and Environmental Design. . . . Your Secretary had a phone call from **Carl Peterson**, who missed the Reunion because of the recent death of his wife, Mary, a sister of our classmate **Earl Payne**, who had passed away in 1953. This time he had happy news; he and Marjorie Payne, Earl's widow, were married on November 4.

We regretfully report the loss of two more classmates, both some time ago. **Eugene Herzog** died on November 16, 1971. He had attended City College of New York before coming to M.I.T. and was older than most of us. At the time of his death, he was in private engineering practice in Dayton, Oh. He had worked with Consolidated Edison of New York on powerhouse design and system planning, and at the Thompson Research Laboratory of General Electric and had been a civilian employee of the Army Air Corps Wright Air Development Division, developing and testing aeronautical components and designing wind tunnels, shops, etc. before establishing his own consulting firm in 1951. . . . **Walter H. R. Cooper** died in April, 1968; he was living in Laverne, Ok., at the time.

The Alumni Office reports the following new addresses: Adelbert N. Billings, 512 Cumberland St. Cumberland, Md.; Prof. Lloyd A. Bingham, 870 12th St., Boulder, Col.; Mr. Richard Cutts, Jr., 44 S.E. 14th St., Boca Raton, Fla., 33432; Henry T. Lyons, 950 N. 33rd St., Allentown, Pa.; Donald A. Sherman, 110-A Lowell Lane, Jamesburg, N.J. . . . If you enjoy hearing of the activities of other 1927 men, perhaps they'd like to hear of you.—**Joseph H. Melhado**, Secretary, 24 Rodney Rd., Scarsdale, N.Y. 10583

28

Greetings to all of you and our best wishes for a very good year ahead! We have had several brief notes in the mail: **Fritz Rutherford** reports all is well on the coast of South Carolina and says his welcome mat is out. He is looking forward to seeing many of you at the 45th in New Hampshire. . . . **Howard Root** writes that he has moved from Montreal to Vermont then to Bermuda in order to "come in out of the cold and taxes—no hopes however, of avoiding death." . . . From **Max Parshall**: "Mary and I are still enjoying retirement. Gardening and music seem to fill most of our time. We do travel some locally and still fish but running across the rocks becomes more difficult as we grow older. There have been fewer out of town visitors this summer."

Jim Donovan had the pleasure of talking with **Homer Burnell** at the Alumni Officers Conference at M.I.T. in October. At that time Homer was planning to go to London and then on to Vienna. Jim thought Homer should be sensible and spend the winter skiing in Europe. Jim also reports that he has reviewed a copy of **Ben Miller**'s posthumous book *Freedom From Heart Attacks*. Jim recommends it highly and suggests it as valuable reading for all '28ers. . . . In addition to his engineering business serving the construction industry, **Abe Woolf** is currently active as President of the Boston Stein Club. . . . **Carney Goldberg** is a past President of the club while **Carl Feldman**, **Dave Olken** and **Dick Rubin** are on the Board of Governors. We might also mention that in addition Abe is President of Temple Beth Zion in Boston. Wife Ruth is prominent and busy as President of the New England Region of Hadassah, consisting of about 35,000 women members.

It was a cold, wet and windy evening in November but six of your classmates made it to the Alumni Office in Cambridge for '28's scheduled telethon session. Jim Donovan, Carney Goldberg, Dick Rubin, Walter Smith, Will Tibbets and Abe Woolf arrived to man the telephones. We couldn't reach everyone, of course, but enjoyed talking with a goodly number of you. The purpose in calling was twofold: 1. To urge and stress the importance of participation in the Alumni Fund. 2. To remind all that our 45 year Class Reunion takes place on June 1, 2, and 3, 1973 at Bald Peak Colony Club, Melvin Village, N.H. We recommend that reservations be sent in early.

Following are some reports from the telephone calls made: **Ben Hough** says he has not retired and does not expect to

retire. He is still working as a consultant "seven or eight days a week." His book on *Basic Soils Engineering* is now in its second edition. Ben's health is good and he has every intention of being present at the 45th. . . . **Jack Rouleau**, retired, finds pleasure working in his greenhouse. His sister lives in New Hampshire near Melvin Village so he plans to get double benefit from his trip on June 1. . . . **Roland Earle** is still busy with his private laboratory where he works on projects for later commercialization. He and Helen expect to reach the Reunion by autotrain travel. Their car will be taken on the same train they ride to Wash., D.C. from Florida. Then they will drive the remaining distance. . . . **Max Alimansky** retired in January of 1972 and has not yet got over the novelty of just resting.

Bob Peatfield enjoyed a three-week trip in Greece and Turkey this past year. He has been in some touch with classmates at Consolidated Edison in New York. . . . **John Connelly** is still hard at work as Manager of Credit Bureau of York, Inc. (Pa.) and as a board member of Credit Reports, Inc., a national organization of credit bureaus. . . . **Rudy Slayter** is another persistent worker. He has his own engineering and consulting business; much of it involves setting up large tanks and boilers. . . . **Ben Draper** also continues to work steadily at guiding his textile firm, Draper Brothers Co., in Canton, Mass. . . . **George Bernat** says that he and Ruth are thoroughly enjoying their retirement at Sarasota, Fla. They are located on a waterway which allows access (by small boat) to the open bay. Golf is still one of George's favored activities.—**Walter J. Smith**, Secretary, 209 Waverly St., Arlington, Mass. 02174

29

I regret to report the death of **Ross M. Pfalzgraff** of Swarthmore, Pa. on September 30, 1972. No further details available at this time.

Frank O. Pierson of Cromwell, Conn., who has been managing a family owned nursery business has retired a little ahead of schedule and plans to work about three or four months in the spring only. His wife Florence has developed "juvenile" diabetes which is partly responsible for change of plans on his retirement and for business reasons as well. They have purchased a 30-foot trailer completely equipped with air conditioning which will enable them to travel to any part of the country where there are good golf courses and water-sports. He is planning to attend a school for color-slide photography, before they start their trailering. He says he will be as free as a bird for our 45th Reunion.

Almer F. Moore of Rockville Centre, N.Y., writes, "During my business career, I traveled on this continent for over 40 years. In retirement, I plan to see the rest of the world, or as much of it as I possibly can." . . . **Edward B. Papenfus** of Vancouver, B.C., writes that his main interest is in investments. Long before it was apparent he foresaw that the price of gold would rise from its artificial price of $35 an ounce and invested heavily in South African gold mine companies with very satisfying results. . . . **Anthony J. Perry** of Washington, D.C. writes, "I am just preparing to leave for Argentina for about four months, under contract by the United Nations to make a hydroelectric survey of northwest part of the country."

Anthony Standen of South Kent, Conn., has just returned from a long trip in Africa. He is active in N.A.A.C.P. and similar organizations. . . . Last June, during Alumni Weekend, we learned that **Bill Baumrucker** of Marblehead, Mass., Vice President of our Class, who is also a Senior Vice President of Charles T. Main, had a recent job promotion. A note from him gives a clue to the nature of his promotion, "With my new job and title, I do much less traveling than I used to, though I still manage a few interesting trips. Doris and I spent three weeks in Europe this spring. We also went to the Dominican Republic several times and next month we plan to spend two weeks in South America. I still like tennis and enjoy sailing, so I haven't taken up golf yet."

Major General **Hugo P. Rush**, U.S.A.F.R. of Manchester, Vt., writes, "Continuing to enjoy retirement. This year, we took a two-month-freighter trip from the West Coast through the Islands of the South Seas, below the equator and beyond the 180th Meridian. We have found freighter travel to be most rewarding, though it does require time and flexibility." . . . **James G. Magenis** of Manhasset, N.Y., writes, "Since my retirement from P.A.A. in 1958, I have been getting a real education relative to our youth of today. After raising two indians and a spoiled daughter, I thought I knew something about kids. Now, as a math teacher at the Eastern Military Academy, I learn something new every day. Each year around June 1, I say to myself that I have had enough of teaching; but when September 1 comes around, I am ready to give it a go for another scholastic year. 'C'est la vie.' " . . . **W. Spencer Hutchinson** of Grand Junction, Colo., has retired from mining and as a Director of Source Procurement Materials, A.E.C. 1970. He enjoys gardening, fishing and bowling on the western slope of Colorado. He has two sons: Bill, the 3rd is in Ogden, Ut., and the younger one, David is in Chicago. The number of grandchildren was up to 13 at a recent count.

Ralph C. Young of Phoenix, N.Y., says "Thank you" for the card we sent him on his 83rd birthday. He sends best wishes to all. . . . **Eric A. Bianchi** of Summit, N.J., writes, "In addition to my 'head hunting' activity with Search Associates, I am now Executive Secretary of Fluid Controls Institute, a trade association of some 65 companies. This keeps me out of trouble, but neither one interferes with my golf, which gets adequate attention. We expect to spend February in Florida. Kay is well and joins me in sending best regards to all." . . . **Henry S. Muller** of Belmont, Oh., lives on a farm with his wife Natalie. He finds the life of farming rather difficult. He seems in need of a little cheering. Why not send him a card, Triple Twin Oaks, Rt. #1, Belmont, Oh. 43718.

A note comes from **Joseph L. Speyer** of Newton, Mass., "Thanks for the card. As you can guess, I am fast approaching the 'Golden Age.' My son Jason, '60, with a Ph.D. from Harvard, '68, just left with his family for Israel to teach and do research at the Weizman Science Institute. I will be retiring as General Agent (Insurance) in October, 1973." . . . Major General **Leslie E. Simon**, U.S.A.R. writes, "I have just received your card upon my return from a trip. I appreciate it an think that sending such a greeting is so kind and thoughtful. Incidentally, I received a related item on my return; a copy of Dr. Bush's lastest book, *Pieces of the Action* which I look forward to reading. Dr. Bush was my very close friend and constant advisor during the period from 1950 to 1955 when I was reorganizing the Research and Development of the Army's Ordinance Department.

Joseph H. Durkee of Jacksonville, Fla., is planning to retire from his post as senior vice president of the First Federal Savings and Loan Association in order to devote more time to the management of his real-estate holdings. He has two sons, one married and the older one still a bachelor. . . . **Murry Brimberg** of Silver Spring, Md., writes that he is still very active in the field of electronics at Brimberg Associates, Inc., and has no thoughts for retirement for a year or two. His wife, Mary also works for the firm and seems to enjoy the hustle and the bustle of the daily toil. Their older daughter, Judy, is preparing to move from Boston, with her husband and two children, to Chicago, where he will become chief of the Department of Medicine at Michael Reese Hospital and Professor of Medicine at the University of Chicago Medical School. Their younger, daughter, Carol, is completing her third year of Pediatric Residency as well as rearing two daughters. Her husband is also completing his third year of residency in Obstetrics/Gynecology. With all the doctors in his family, he thinks that his retirement plans may not be entirely his own making.

William W. Saunders has just moved to Naples, Fla., after living in Gifford, N.H., for 18 years. He retired from his construction business four years ago and used to spend six months in N.H., and six months in Florida, the dream of most retired couples. "Florida is a little warm" he says in his note, "but we think it is great. My wife Elinor and I travel about during July, August and September. Golf is my principal hobby with fishing a close second." Bill was among the first graduating class, along with your Secretary, from Course XVII, now part of Civil Engineering. . . . **Milton Male,** of Pittsburgh, Pa., writes, "Now that I have retired, I spend a good deal of time trying to improve my golf game. I also take pleasure in reading as well as visiting with our children and grandchildren, located in Connecticut and Florida. My wife Maxine and I are enjoying our retirement immensely and take occasional cruises for vacation. Regards to all."

Professor **Clifford P. Kittredge** has been retired from Princeton University since June 30, 1971, but remains active in his practice of consulting engineer. He is also active in participating in committees of the American Society of Mechanical Engineers. . . . **Ira H. Abbott,** of Moulton-

boro, N.H., writes that he is enjoying his retirement and does some consulting work. The last assignment was in California which lasted through the winter and spring. He does some hunting, fly fishing and odd jobs around his ancient farmhouse and grounds.

George J. Meyers, Jr., of Wyoming, Pa., is still active in his own business, known as Management, Motivation and Economics, Inc., and would like to hear from anyone who has a profit or personnel problem. He is also very busy in civic and church affairs, teaching in Sunday school etc. He concludes his note, "All hobbies will come to a grinding halt on January 1, 1973."—**Karnig S. Dinjian**, Secretary, Starlight Towers, Apt. 14-E, 60000 N. Ocean Blvd., Fort Lauderdale, Fla. 33308

30

This month we have reports from three classmates who indicate that they have retired, but failed to state either their date of retirement or what they had retired from. Under these circumstances collateral records are sometimes helpful. . . . **Merritt Hulett** apparently retired some years ago, since it was necessary to go back to the 1961 Alumni Register to find that as of that time he was President of Vermont Associated Lime Industries Inc. The Industries Huletts are living in Rockport, Texas, and have two married daughters. Merritt lists saltwater fishing and collecting U.S. postage stamps as his hobbies. . . . **Allan Intriligator** was a management consultant prior to his retirement. The Intriligators live in Freeport, N.Y., and have three children. . . . Prior to his retirement, **Langley Isom** was Director of New Product Development for Reeves Brothers Inc. The Isoms live in Yarmouth Port, Mass., and have two married daughters and seven grandchildren. Langley lists his hobby as cruising under sail. . . . **Bill Jackson**, who is Board Chairman of Pittsburgh Des Moines Steel Co., has been active in the Boy Scouts for many years. He is a member of the National Executive Board and National Executive Committee, Chairman of the National Program Committee, board member of the Regional and Local Councils, and Chairman of Jamboree-East. In the latter capacity, he will be host to some 35,000 Boy Scouts who will be attending camp at Moraine State Park (near Pittsburgh) August 3-9, 1973. He suggests that "anyone interested in seeing the finest youth of the country in action should stop by and see a great show."

Bill reports having recently see **Jack Bennett** and **Wally McDowell** (both retired), and **Arthur McCullough** who is still working. . . . **Bill Wye**'s comments on the flap of his Alumni Fund envelope tersely reads: "Progress in golf retro-active direction; stock market status cryptic." . . . **Walter Soroka**, Dean of Continuing Studies at the University of California, has been appointed by the California legislature to an advisory committee to undertake a study of noise pollution.

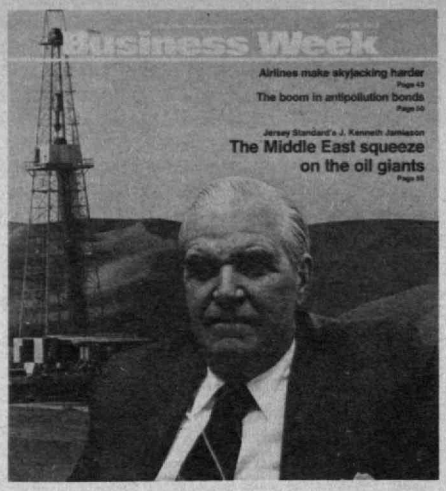
We regret to report the receipt of a notice that **Trevor Cramer** died on September 17. Mrs. Cramer kindly sent us a newsclip containing a review of his career. After graduating from M.I.T., Trevor took graduate work in accounting at Northwestern and then went to work for P. R. Donnelly and Sons of Chicago. He served as controller until he was transferred to their Crawfordsville, Ind., plant in 1939 as resident manager. In 1946, he resigned and formed the Plastene Corp. He served Plastene as President and Chairman of the Board until 1957 when he became President of Thermos Products Co. of Norwich, Conn., Plastene's then parent company. He served in that capacity until 1961 when he joined Wallace Press of Chicago as President of its commercial printing division. In 1966, Trevor returned to Crawfordsville as Board Chairman of Ingress-Plastene, serving until his death. Trevor was a member of the First Church of Christ, Scientist of Crawfordsville. He was also a member of the Masonic Lodge, past director of the Society of the Plastics Industry, director of the Indiana Vocational Technical Institute, and a member of the Plastic Pioneers of America. Trevor was also active in community affairs and served on numerous committees for betterment of the community. In addition to his wife Patti, he is survived by five daughters, three sons and 14 grandchildren.

Changes of address: Richard G. Foster, Top o' the Cod, Horizon Dr., Chatham, Maine; George E. Kloote, 1160 Beach Dr., Holland, Mich. 49423; Leroy F. Marek, Box 612, North Falmouth, Maine 02556; Horace W. Myers, R.M.I. 236, Lake Joyce, Fla. 33539; Dr. Robert D. Nutting, P.O. Box 26, Yorklyn, Del. 19736; John B. Osborne, 112 Mill Rd., North Hampton, N.H. 03862; Granger D. Schrader, 128 Browning Lane, Bryn Mawr, Penn. 19010; Watson E. Slabaugh, 476 Chevy Chase Rd., Mansfield, Oh. 44907; C. Haskell Small, 4100 Cathedral Ave., N.W., Apt. 617, Wash., D.C. 20016; Parker H. Starratt, Duncan Rd., Chesterfield, N.H. 03443.—**Gordon K. Lister**, Secretary, 530 Fifth Ave., New York, N.Y. 10036

31

Don't forget our 42 year Reunion on March 15, 16, and 17 in Mexico City. . . . **Juan Bolanos** writes that he retired in March, 1972, and had a grand time at the last Mexican fiesta. After that, he travelled in Central America and is now working as a consultant for Rand McNally. . . . A notice from the Alumni Association tells that **Gordon Brown** has been elected a member of the Board of Directors of the Asian Institute of Technology Foundation, in Bankok, Thailand. . . . **Dan Cook** says his present major activity is concentrating on a commercial pilot license, after which he hopes to get an instrumental rating. . . . **Albert** (Skeets) **Dean** retired from the Budd Co. early in 1970 to do some of the things he never quite had enough time for. He is still doing some consulting, mostly for the Budd Co. . . . **Horace Ford**'s new address is P.O. Box 1048, Stuart, Fla. 33494.

Henry Grinsfelder has been appointed



J. Kenneth Jamieson, '31, found himself on the cover of Business Week *in midsummer—and quoted inside as saying with confidence, "I can assure you that we have the resources to overcome our difficulties." He was then Chairman of Standard Oil Co. (N.J.)—which was shortly to become Exxon Corp.—and the problems of that transition were only some of the issues to which Mr. Jamieson was responding in the quotation.*

The Confident Mediator in the World's Largest Oil Enterprise

Two big problems—and a few smaller ones—all coming together brought J. Kenneth Jamieson, '31, into a brighter part of the business spotlight than that to which he is accustomed last summer: the change from a buyer's to a seller's market in international oil, and the organizational changes associated with transforming the Standard Oil Co. (N.J.) and its Humble Oil and Refining Co. subsidiary into Exxon Corp., of which he continues as Chairman.

Other problems were cited by *Business Week*, too, in a midsummer report on Jersey Standard: as a multinational company, "growing pressures from Congress, labor, and foreign governments" to restrict operations; "surging energy demand" in the face of mounting supply difficulties, attack from environmentalists because the company's products are identified as a primary source of pollution.

But *Business Week* said Mr. Jamieson "exudes an aura of solidity and dependability" which has helped him build "a reputation . . . as an effective mediator between clashing egos or points of view." Nearly 60 per cent of Exxon's oil reserves are in the Middle East and Africa, and Mr. Jamieson's talents as mediator can hardly come amiss in future negotiations with the Organization of Petroleum Exporting Countries.

"I don't pretend to know all the reasons for the turmoil of our society today, but I suspect it's . . . the failure of our institutions to respond well enough to the public's ever-increasing needs and wants."—Charles B. McCoy, S.M.'32, Chairman and President of E. I. du Pont de Nemours and Co.

The Differences Between Expectations and Realities

The biggest problems of business have more to do with reputation than with record.

That is Charles B. McCoy's (S.M.'32) way of emphasizing what is right and what is wrong with American business: public expectations—in the form of social and environmental concerns, for example—have been going up very rapidly; business performance has been rising, too, but it "necessarily has followed along on an arithmetic curve.

"People asked a great deal more of business, and when it delivered a little more it seemed somehow to add up to less."

Mr. McCoy, who is Chairman and President of E. I. du Pont de Nemours and Co., Inc., calls this "the calculus of expectations." In a large sense, he writes in the first issue of *Context*, a new du Pont magazine, American business is the innocent victim of this kind of mathematics: "Business has a great deal of positive evidence on its side; . . . the record is nothing to be ashamed of."

The public gives firms closely identified with technology special obligations, Mr. McCoy thinks. People think of science and engineering as "powerful tools," and impatience is focussed especially on companies presumed to be powerful because of their competence in these fields.

Even if the situation is different, the role of technology in this process is a constant; Mr. McCoy describes it in R. Buckminster Fuller's words: "to do more with less."

The "primary drive" of technology, writes Mr. McCoy, "is toward the more effective use—and conservation—of human and natural resources," and it always has been. "Society's interests do not lie in restraining technology. The objective should be to increase technical capabilities and apply them to projects the public finds most worthwhile."

Corporate Director of Employee Health for Rohm and Haas. . . . **John Jamieson** has been appointed to the National Industrial Pollution Control Council. . . . **Addis Kocher** writes that he retired January 1, 1972, after 40 years and three months in the engineering department of the Bendix Corp., working on autopilots. . . . **Jim Rogers** tells us that after retiring as Captain in the Navy, he taught school for 11 years, finally retiring from teaching in June, 1969. He is now living in Rossmoor, a retirement center in Walnut Creek, Ca., and loves it. . . . **Joe Shimek** writes that he retired from the presidency of Geophysical Association Internation on July 1, 1971. . . . Rear Admiral **Arnold E. True** says he retired from the navy in 1946 and from teaching as Emeritus Professor of Meteorology in 1968. He is now raising cattle in the Santa Cruz Mountains and has just returned from a trip to Thailand, Vietnam, the Philippines, and Japan.

The saddest part of these notes is to report the death of the following classmates. Our deepest sympathy to their families. Colonel **Francis Crotty**, August 20, 1972; **Carl O. Svenson**, January 9, 1972; **Irwin M. Lord**, March 1, 1972; Dr. **Nathaniel Coburn**, June 22, 1971; **Robert G. Fulton**, July 25, 1972; **Jacob Gordon**, July 26, 1972; **Scott Ritchie**, April 28, 1972; **Samuel Waldham**, July, 1972; **Gil Roddy**, October 15, 1972; **Donald Dunklee**, September 12, 1972; **Wendell Currier**, November, 1972.

This is being written in Australia and a last-minute note from home contained the following. **Randy Binner** has been elected Vice President of Great Lakes Carbon Corp. He will continue as Chief Engineer. . . . **Ralph Davis** has been awarded the 1972 Bronze Beaver Award. . . . **Charles Norris** has resigned as Dean of the University of Washington, for health reasons. Hope you all had a Merry Christmas and that 1973 is good to you. —**Edwin S. Worden**, Secretary, 35 Minute Man Hill, Westport, Conn. 06880

32

Retirees make news for this issue. **John A. Fellows** is busy as a full-time consultant to the American Society for Metals since his retirement from the Uranium Division, Mallinckroft Chemical Works, Weldon Springs, Mo., involved in editorial work on the forthcoming volumes of the A.S.M. Metal Handbook. . . . **W. E. Skelton** has retired as Assistant to the Manager of Texaco's research laboratories in Port Arthur, Tex., after a most successful career in the field of lubricants wherein he holds some 30 patents. . . . **H. Everet** "Hi" **Clements** has joined Graphic Arts Supply, Inc., Rochester, N.Y., as Division Manager covering the area of Western New York. . . . **Alva T. Wilson**, after 24 years with Atlantic Research, has become an entrepeneur of a small business activity at Green Harbor, Mass.

We are sorry to report the passing of one of our classmates, Dr. **William Liben** on November 11, 1972. Mr. Liben was a biomedical research scientist with the Johns Hopkins Applied Physics Laboratory. He was the founder of a research group in the field of microelectronics and also made early use of transistors in the problems of navy ship building. Born in Malden, Mass., Dr. Liben received a doctor of science degree at M.I.T. He specialized in optics, photography, high vacuum engineering, evaporation, and oil well instrumentation. Just prior to World War II, Dr. Liben was a physicist with the Corps of Army Engineers' Research and Development Laboratories at Ft. Belvoir. He worked with the Premier Crystal Laboratory in New York and the Brookhaven National Laboratories on Long Island before joining Johns Hopkins in 1950.

He was a member of the American Physical Society, the Optical Society of America, the Institute of Electrical and Electronics Engineers, and the American Vacuum Society. We extend the sympathy of the Class to his wife Catherine and daughter Susan.

John A. Robertson died very suddenly November 11, 1972 in Wash., D.C., on his return from a business trip to Europe. John had represented the interests of the U.S. Gypsum Co., in Washington for many years and was very active in all types of research and government specification work, both national and international, for the building construction industry.

Alwin B. Newton has joined the ranks of the individual contracting consultants since his retirement as Vice President for Research of Borg-Warner's York Division.—**John W. Flatley**, Secretary, 6652—32nd Street N.W., Wash., D.C. 20015

33

Happy New Year to y'all and we start from there. First allow me to congratulate myself for having received almost 25 per cent replies to my October letter of entreaty. Many of the most promising have not yet signed in, but first, a couple of news releases.

Charlie Payne, paperman extraordinaire for Eastman Kodak, was scheduled to reach retirement as of January first. Charlie is prepared for the worst (or best) as he has been assigned by Eastman to a special responsibility for the interim period between October and January 1. The release sayeth not just what is special about "en route to pasture," but Charlie has been one of the top men for years, so perhaps the assignment speaks for itself. Charlie, your classmates wish you well, and of course, will expect you at the 40th Reunion. . . . An Alumni Fund capsule tells us that **Forest P. Dexter, Jr.**, has already retired, as of June, from teaching at Union College where he was a Professor of Geology, and acting Dean. Son, Stephen, is a Ph.D. from Delaware, and is associated with the Woods Hole Oceanographic Institute, in Marine Engineering. Daughter, Jeanne, is a portrait painter in N.Y.C. Why don't more of you fellas use those return cards. Of course, you have to put in a check to qualify, but that ought to be no great deterrent. Incidentally, these alumni fund envelopes are the only way I hear from some classmates. . . . **Prentiss Huddleston** announces that he is President of

Huddleston, Satterfield, Evans, and Mauney, Architects and Engineers of Tallahassee, Fla.

Another press bit, this from a **John Wiley** source, most of which was covered here earlier. John cannot write, apparently, but he has other ways of making himself heard. As of August, '72, J. E. Greiner, Inc., Tampa and Baltimore Consulting Engineers, has acquired John as a Special Consultant for airports, and as a Director of Greiner's European counterpart, Greiner Co. Ltd. After being with American Airlines, and World War II service, John worked for the New York Port Authority, and very soon became Director of Aviation, in charge of all four airports: J.F.K., LaGuardia, Newark, and Teterboro. Retiring this year, he became Visiting Lecturer at the United Nations Development Program at Beirut, and at the beginning of this academic year he became Visiting Professor at M.I.T. in the Flight Transportation Lab. John belongs to so many different things it's impossible to list them all here. In 1970, France decorated him with the award of Knight of the French Legion of Honor. John may be the only classmate with this distinction. Any comments? To John personally, we appreciate and honor you for your distinguished career.

Henceforth I will use the word "special," and this will denote that Spec. means one who replied to my October letter, and also means thanks for cooperating. Spec. **Louis Alpert** assures me that he wishes to help a classmate in distress. Not so, Louis, the Class is in distress if we don't get out notes in all issues. Louis is completing 38 years with American Smelting, with four years to go before retiring; fourth grandchild coming up in December, which makes it two boys, one girl, and one not yet classified. Daughter Susan is now living in Chicago, as her husband is a professor at the Illinois Medical School. Son is a junior at the Indiana University School of Business. The Alperts plan a two-week visit to Mexico in November, a laudable idea, except that it ought to be in March so as to visit with the Mexico City Club Fiesta Gang. Louis hopes to see me at the 40th; if the actuary tables will permit this to come to pass. I have every intention of being there with my pet, Leona. . . . Spec. **Carl Swanson** makes with the congratulations, and hopes for a fine cruise. He is still commuting to work in Hampstead, L.I., by subway and bus. He has been working this year on something special for Sperry Gyro at Lake Success, which has proven to be a change, at least, from routine. Sayeth not just what, so it may be classified. The Swanson's have toyed with the idea of moving further out on Long Island, but have decided that they would not better themselves, inasmuch as retirement in 1975-6 might be a better time to make any moves. How about the 40th? Write Westy if you can make it.

Spec: we have a dandy from **Jim Norcross** in the form of what seemed to be an application for a job, but the contents proved that Jim was just being methodical. Here is my first look at the Norcross family as it is today. Jim and Helen have three girls, one not married and is studying at the Pendle Hill Quaker Study Center. Another is married to an engineer, and she has two girls. Another is married to a college language professor, and they too have two girls and a boy. . . . I stopped in Pennsylvania to see **Bill Baur**, and I also saw the Norcross home. I can well visualize that they enjoy Media, too what with a fine home, complete with swimming pool. I seem to recall that Jim has, in the past, been very active in work for the blind. Jim is still Executive Vice President of the Arco Corp., makers of welding materials and equipment. He is also President of an Arco subsidiary, the Electrotherm Corp., and in connection with one of these, he recently visited Czechoslovakia, where he was a speaker at a world conference on electroslag welding. For both business and pleasure, the Norcorsses visited East Germany and Western Europe.

We have a fine note from **Ivan Getting**, a fella that never ignores my many requests for family information. The Gettings have sold their beautiful home in Los Angeles, and have bought a condominium at Marina Del Ray, Calif., located right on the beach, overlooking the broad Pacific. They should be all moved and settled by Christmas, and will be ready for personal calls by classmates. Fellas, Ivan really means this, as I know of several who have called on him in the past. They will miss the great home they have left with its swimming pool *et. al.*, but "the object is to simplify life, and make it possible to have more time for visiting. Should anyone be coming by, we would be happy to see them at 4 Lighthouse St." Ivan, we salute you, and thank you from the heart for taking time to write us. While I think of it, all class mail will be forwarded to me at five major stopping points in the Pacific, so please don't start counting on a vacation from writing your Secretary.

Spec: now comes a fine letter from **Henry Kiley**, my long time good and true friend ever since we first saw each other in Cambridge way back when. You will recall that Henry taught at M.I.T., then joined W. R. Grace Co., where he is now Chief Engineer of the Industrial Chemicals Group, though he is at present on sick leave with a persistent respiratory condition. He brings me up to date on the Kiley family. Henry was one of the few who found his life partner right there at M.I.T., the former Mary E. (Betty) Killian Kiley, M.I.T., '31. Mary is in perfect health, as Henry probably will be also. Daughter, Mary E., is a Smith grad, working in N.Y.C. as a freelance writer in technical research. Son, Henry Jr., is a grad of Notre Dame, served a stint in the Air Force, and is now a Captain with Western Airlines, based in San Francisco. He is married with one child. Number two son Kevin, grad of Tufts University, math major, served his bit in the navy, and is now a systems analyst with a New Jersey insurance co. He is married but has no children. We all hope that Henry makes a speedy recovery from his annoying trouble. We all send our best to both you and to our fellow alumnus, Betty. Many thanks for writing and for your best wishes. Y'know, fellas, I feel a little sorry for all you old fellows, and will more, when I visit Tahiti and Bali, come January.

I have been requested by **Bob White**, Class Agent, to make mention of our forthcoming 40th Reunion, and the 40th Fund. I told Bob that I could not possibly become a fund raiser and remain in the good graces of the hoi polloi. Westy tells me that a few of the boys have actually committed themselves to attending the 40th. I have assured him that some will write him (see below), but ten times that number will attend. Please note the addresses below; mine in Fla., and your 40th Reunion Chairman. That's it for now, fellas and gals. No point in asking for any immediate news now, as the Notes through May will be written before the cruise starts. Happy New Year.—**Warren J. Henderson**, Secretary, 1079 Hillsboro Beach, Pompano Beach, Fla. 33062; **Clarence R. Westaway**, 247 Commonwealth Ave., Boston, Mass. 02116

34

I have only two items this month and unfortunately one of these concerns the loss of another of our classmates. The Boston papers carried the obituary of **Philip A. Daniel** who died on October 27 past. At the time of his death he was a Senior Estimator with Stone and Webster Engineering Corp. He had started with the Ohio Edison Co., after graduation and worked with firms in Alabama, West Virginia, Pennsylvania, Illinois, and New York before joining Stone and Webster in 1964.

During World War II he had served as a first assistant engineer aboard an army Transportation Corps tanker in the Pacific. He is survived by his wife, Helen, a daughter, and three grandchildren. On behalf of all our Class I extend our sympathy to Mrs. Daniel.

My other news comes via the Alumni Fund and sounds like we have another retired member. **James Burke** writes: "Without going into the whys and wherefores of it, I have been living here on St. Simon's Island, Ga., since April 1970. Am enjoying the good life and have embarked upon a new career in real estate. I shall be pleased to welcome old classmates, visiting the Island or the Cloister on adjacent Sea Island; c/o Glynn Realty, 3505 Frederica Rd., St. Simon's Island, Ga. 31522.

Another year will have passed when these notes reach you. I hope that the New Year will bring health and happiness to you all.—**Robert M. Franklin**, Secretary, Satucket Rd., Brewster, Ma., 02631; **George Bull**, Assistant Secretary, 4961 Allan Rd., Washington, D.C. 20016

35

Sid Grazi's letter arrived just in time to be included: "Ann and I just returned a few days ago from our trip to Hawaii. Ann didn't want to come home, but like all vacations, there had to be an end. We arrived in Denver in time to catch our first two snowstorms in quick succession. The first one caught Ann and me on the second hole at Green Gables so we

made a dash back to the clubhouse. Two days later we got 15 inches from the second storm, and now two days afterward, the snow has pretty well disappeared. Quite a contrast from Hawaii where we played golf almost every day. I even tried some body surfing at Makaha Beach after golf. Enroute to Hawaii, we spent a few days in Hillsboro, a few miles south of San Francisco. . . . I finally contacted **Ham Dow** the day before we left and found out that he and Edith had just returned from Spain early that morning. We therefore had to postpone a potentially interesting golf match and visit to a later date. Just received the 'Cup' and will display it in a prominent place in our library at home. I noticed that the plaque has room for no more than four winners. Are you trying to tell me something?"

Earlier, Sid had appended the following note on his questionnaire returned to **Bob Forster**: "I am still taking great pride in helping build our adopted state of Colorado and Denver in particular. My company, Titan Construction, is active building schools, hospitals, office buildings, hotels, etc. We have also completed some engineering construction such as a Stapleton Airport parking structure, and a water treatment plant for the city of Grand Junction. Would love to welcome any classmates visiting this area." . . . More of the appended questionnaire notes follow, this one is from **John D. Hossfeld**: "We're rattling around in the old homestead. Out of four kids, we have only one left at home. Personally, I was retired a year ago, took another job, but am looking again. Daughter Georgina, a former Miss Massachusetts, was married July 1 to a navy flier. They are now Texans."

Wilfrid A. Greenwell, Jr. wrote: "I've had a life which has been most interesting and rewarding and have enjoyed it immensely, but I don't really think that most of its items would, piece by piece, prove very illuminating to anyone in the Class except those who know about me from continual contact over the years. This may all sound rather negative, but it isn't meant to be; it's just that I'm not the reunion type, and am somewhat appalled by the huge mass of buildings and activities of M.I.T. today—just too much for my taste, really. No objection, but it isn't my style. Good luck on the Reunion." . . . **Fred Tone** wrote: "Operating in new product engineering at Kodak. Three kids —all married. Four grandchildren. Had a good time at the Reunion (Homecoming) in Cambridge."

From **Richard L. Hughes** came: "Doing advance planning for computer applications in the Management Systems Dept. of Hamilton-Standard Div. of United Aircraft Corp. Taking time off to travel and see the world. I also must travel to see my family." . . . and from **Edward Hoffman**, "Entered my own business upon graduation. Served in the army 1941-1945. Married in 1946. Have three children ages 21, 17 and 14. Still with my own business, Superior Chemical Products Inc. dealing in insecticides for P.C.O. and municipalities."

Latest address changes show that **Jack Colby** is back in Florida for the winter. . . . A note from **Otto Zwanzig** tells of a new business he is getting into. I spent a delightful evening with Otto and Alice at their lovely Denver home back in September. My wife, Doreen, spent parent's weekend with our freshman daughter Pamela at Colorado State on the way home from a business trip to San Diego. **Pete Grant**, **Bob Forster** and I attended the last M.I.T. Alumni Advisory Council dinner meeting and heard all about plans for the Space Shuttle.

I am sorry to have to report another death in our class: **William D. Kiebler**, in Dallas on September 30, 1972. . . . Please resolve in the year 1973 to write your Secretary.—**Allan Q. Mowatt**, Secretary, 61 Beaumont Ave., Newtonville, Mass. 02160

36

Last month I reported that our Vice President, **Henry McGrath**, as President of the American Section of the Societe de Chimie Industrielle, was toastmaster at a dinner in New York and now I find that the Class was also represented by **Harold Miller**. Henry is Eastern Sales Representative for Procon, a firm which designs and constructs plants for the petroleum and chemical industries. . . . **C. Donald Brown** writes that he is receiving considerable satisfaction from his work on the staff of George Washington University, with most of his time in the past four and one-half years having been in the Continuing Engineering Education Program concerned with short, noncredit courses.

Last month, I reported the death of **Donald W. Kenny** in June. He was a Director and Vice President of Rohm and Haas Co., in Philadelphia, having joined the firm in 1945. For several years he was in Houston, Texas. He is survived by his wife, Audrey, a son, daughter, and grandchild.—**Alice H. Kimball**, Secretary, P.O. Box 31, West Hartland, Conn. 06091

37

As **Bob Thorson** previously reported, this will be my first attempt to help him as Assistant Secretary. **Ralph B. Chapin** of Batavia, N.Y., is spending increasing amounts of time as President of the fledgling Citizens For Ecological Action, Inc. They just stopped the consulting engineer's study recommendation to the Department of Transportation for locating an international jetport in their country. He is also a director on a new board, setting up a crisis phone facility called R.A.P. He keeps in touch with the academic world by taking courses at their new community college. In June and July he vacationed in the Northwest where they have a daughter in college. . . . **Norman A. Birch, III**, writes from Jackson, Mich., that after almost 12 years, he is terminating his job and leaving Michigan. For some time now, he and Elvie have "been feeling that life is short and grows ever shorter." He would like to enjoy life "the most," so for a starter he intends to spend this winter, or at least a large part of it, in Spain. His plans beyond that are indefinite, although he expects to be at Gull Rocks in South Carver, Mass., next summer. Norm won't leave the business world completely but has not decided just what he'll do, perhaps some consultant work. Contact may be made through his son: c/o Eric Birch, 405 Highfield Rd., Louisville, Ky. 40207. During the year he made a business trip to Mexico City, then to Bogota, Columbia, and Caracas, Venezuela, followed by a week of vacation in Grenada, West Indies. Visits with their young people and the sight of their grandson Alex growing and developing added much joy. They have no idea where they will be at Christmas, they suggest that when you come to their name on your list, you send "Merry Christmas" on a thought wave and when they feel a warm glow, they will be getting your message. . . . If any others of our class have sent out Christmas letters, how about a copy to your class secretary so that excerpts may be taken for the class notes.

Your Assistant Secretary heartily endorses Norm Birch's decision to start *now* enjoying life "the most." The loss of my wife, Betty, emphasized to me that we haven't much time left. On June 15, shortly after our 35th Reunion, I left for Jerusalem, Israel, as one of the U.S. representatives to the Sixth International Conference on Water Pollution Research. Following the seven-day meeting, I toured the country for almost two weeks. I completed my Israel stay with a three-day memorable visit to Kibbutz Alumot on the Sea of Galillee where Judy Seder Norda (**Leonard Seder**'s daughter) lives with her husband and two-year-old daughter. Gioconda and **John Fellouris** had urged me to stop in Athens, Greece, on my return. Although John had not yet arrived, Gioconda and her three daughters were wonderful hosts. Beautiful Gioconda in her native Greece is a sight to behold. Returned to the U.S. July 8. During the rest of the summer I managed to visit Monhegan and Chebeaque Islands off the Maine coast and take a six-day cruise on the clipper schooner *Shenandoah*. She left from Martha's Vineyard and put in at Nantucket, Elizabeth Islands, and Dartmouth, Mass. I am now back in Peabody, consulting on environmental engineering three to three-and-a-half days a week.

Bob Rudy writes on his way to the Orient, where he expects to meet other M.I.T.'ers in Bangkok, Hong Kong, and Tokyo. He and Joan expect their first grandchild. . . . **Sydney B. Karofsky**, still living in Weston, Mass., was elected a member of the Board of Directors of Commonwealth Bank and Trust Co., of Boston. He is President-Treasurer of Northeastern Wallpaper Corp., and Northeastern Wallcoverings, Inc., both of Boston and Hartford; and Walls Unlimited, a Boston designer's showroom. He also serves as Vice President of Hebrew Rehabilitation Center for the Aged, in addition to being a trustee and chairman of the Art Committee. . . . It is with sorrow I report the death of **Charles H. Fager** on October 6, 1972.—**Lester M. Klashman**, Assistant Secretary, P.O. Box 961, Peabody, Mass. 01960. **Robert H. Thorson**, Secretary, 506 Riverside Ave., Medford, Mass. 02155

H. Tyler Marcy, '40. James F. Healey, '41.

38

Johnny Summerfield writes that he has resigned as Vice President of Pan American World Airways to form Summerfield Associates, consulting and analysis in management information systems, in distribution systems and in transportation and logistics systems. . . . **Bruce Leslie** was recently elected Senior Vice President, Director of Underwriting for Allendale Mutual Insurance Co., of the Factory Mutual Group. His commercial goes on to say "we specialize in industrial and institutional property insurance for many of the nation's largest corporations." He reported that he had recently seen **Gordon Hunt**, who is now an enthusiastic yachtsman and still with the Torrington Co.

By now you should have all made your plans for the Mini-reunion in Mexico City, March 15 and of course the full scale Reunion at Stratton Mountain, June 2-3. **Paul Black** is working busily, enlisting our Reunion Committee. Plan to arrive Friday night at Stratton Mountain Inn—it's a beautiful place, and the more time we can spend there, the better. We're there until Sunday when we come down to Cambridge in time for the International Buffet before going to Pops—the all-M.I.T., just-for-us concert with Arthur Fiedler conducting. Alumni Day is going to be another really exhilarating time, so far, it's a surprise! All in all, we 1938 Beavers will have a dam good time.—**A. L. Bruneau, Jr.**, Secretary, Hurdman and Cranstoun, Penney & Co., 140 Broadway, New York, N.Y. 10005

40

Tyler Marcy is the new President of the Instrument Society of America. He is a consultant in automatic data processing and control and formerly director of technology for IBM Corporation, Armonk, New York. . . . **Connie Schuerch**, who is professor and Chairman of the Department of Forest Chemistry at the College of Forestry, State University of New York, Syracuse, has been awarded the Anselme Payen Award of the American Chemical Society's Division of Cellulose, Wood and Fiber Chemistry. Connie is the author of many scientific papers, including 87 directed to lignin, and is also on the editorial advisory board of the journal *Macromolecules*. . . . **Russ Haden** has been awarded the 1972 Bronze Beaver by Tech for his work as Class President, alumni day chairman, Alumni Association Vice President, and member and chairman of many committees in the Alumni Association. . . . **M. Spalding Toon** is now president of the Bessemer and Lake Erie Railroad Co.; the Union Railroad Co.; the Elgin, Joliet and Eastern Railway Co.; and the Duluth, Missabe, and Iron Range Railway Co. Spalding has been in the transportation field since graduating from Tech. That's the news in brief. For a longer and better column, write Al—**Al Guttag**, Secretary, Cushman, Darby & Cushman, 1801 K Street, N.W., Wash., D.C. 20006

41

Thanksgiving has not yet occurred and Christmas is in the distant future, and here we are writing the January issue Class Notes. So, if I wish you a Merry Christmas, I am too late, and a Happy New Year sounds ridiculous in mid-November, but that is the way it is in the journalistic business. Happy New Year to all of you!

The clipping services have been busy this month with news about the Class of '41. First news that **J. Paul Sanderson** has been promoted to Vice President of Arthur D. Little, Inc., in Cambridge. He joined A.D.L. in 1948 and in 1968 became head of the corporate and public management division. He has devoted particular attention to corporate planning assignments for corporations in process industries. Congratulations, Paul. . . . A note from the *Herald News*, Fall River, Mass., carries a story on **Richard F. Cottrell**, President of Aerojet Solid Propulsion Co., who has his sights set on the space shuttle program recently advocated by President Nixon. Richard became familiar with such rockets in 1956 when he went to Aerojet to assist in the development of Minuteman and Polaris propulsion systems. Richard's company's rockets are also responsible for placing communications satellites in their geosynchronous orbits. It's comforting to know that a Class of '41 man is responsible for helping us see such things as the Olympic Games via satellite.

The Singer News from New York shows **James F. Healey** appointed Vice President of Research and Development for The Singer Co. He has also held executive positions with I.T.&T., Honeywell, and Bell Aircraft Corp. Our best wishes to Jim.

We will see you in the next issue. Nantucket continues to enchant.—**Michael Driscoll**, Secretary, 23 Broad St., Nantucket, Mass. 02554

42

A final report on our 30th Reunion at the Wychmere Harbor Club was sent in by **Harvey Kram.** Harvey had just received the final accounting on the Class Reunion from our Treasurer, **Marty Levene**. Receipts for the Reunion exceeded expenses by $253.63. This sum has been added to our Class Treasury and '42 is still solvent! We are looking forward to a bang-up 35th Reunion.

Kodak recently announced that **Jim Littwitz** has been appointed Assistant Manager of their paper manufacturing organization. Jim's previous assignment was Director of the Project Development Division. He began his career at Kodak in 1945 as a Chemist in the Synthetic Chemical Department. . . . **Paul Hotte** has been elected a Director of the American Management Association. . . . **Art Sweeney**, recently promoted to Major General, U.S. Army, has been assigned as Commander of the White Sands Missile Range. Art's recent assignments were Commanding General of the U.S. Army's Support Command at Da Nang and as Commander of a Support Command at Qui Nhon, both, obviously, in Vietnam. . . . **Bob Cunningham** spent part of last summer in England as the U.S. representative to the World Meteorological Organization, working on weather modification. . . . **Cal Morser** has moved to Wilton, Conn., and is working as Director of Optical Systems at Perkin-Elmer Corp., in Norwalk. His activities include laser communication, high energy laser systems, astronomy programs, and earth resource projects.

Al vander Kloot joins the ranks of '42 parents of M.I.T. students with his son Bob registered in the class of '76. . . . Your editor and spouse spent an enjoyable evening at the New York Alumni Center's cocktail party and tour of the Whitney Museum on November 9. The party was jointly sponsored by the New York Center and by M.I.T.'s Commission on the Arts. Our Class was well represented by Janet and **Adrien Marcuse**, Erna and **Geza Neuman**, Rhoda and **Alan Katzenstein**, Francine and **Jim Stern**, Margot and **Eric Wormser**, **Floyd Lyon**, and **Jon Noyes**. . . . Holiday Greetings to all.—**L. K. Rosett**, Secretary, 191 Albemarle Rd., White Plains, N.Y. 10605

45

As we await **Bill Shuman**'s phone call and his status report on our March mini-reunion, let us turn to other items. **Chris Boland**, **Jim Levitan**, Ray Grammer, **Bob Maglathlin**, and yours truly represented 1945 at the Alumni Officers Conference in Cambridge last October. Corporation Member **Jeptha Wade**, together with his charming wife and classmate, **Paddy**, attended Jerry Wiesner's Reception. While Jeptha attended to Corporation business, good wife Emily enthralled us with her zoo activities, i.e. The Boston Zoological Society. One must be specific as many of us refer to home, the office, or both, as the zoo!

Arthur E. Miller of Princeton University wrote the following on October 29. "The project I have been working with here at Princeton was responsible for the big telescope placed in orbit a few weeks ago. Everyone associated with the project is elated (and relieved!) that all has gone so well as it took 12 long years from initial design studies through design, development, etc. and lastly, launch. In January we will be making our first detailed report at the American Astronomical Society Meeting." Art's enthusiasm reminds me of the new father and his first-born, and rightly so.

Billie and **Al Bowen** spent an evening with us here in New Castle in mid October; Frannie and I are still smarting from the thrashing we received at the bridge table. Possibly we can gain our revenge while flying to Spain in March. Last month we reported **Jim Hoaglund**'s address change; now for his activities: Jim has been named Manager of Corporate Planning and Development for McQuay-Perfex, Inc., a Minneapolis-based manufacturer of air conditioning and heat transfer products. Jim previously had been a technical director with Research and Development responsibilities both here and overseas for I.T. and T. Jim, I suspect you are enjoying the fruits and labors of small town living after several years in the Manhattan broth!

We continue to be awed by the many honors thrust upon **Jay W. Forrester.** The latest awards are his election as a Benjamin Franklin Fellow of the Royal Society of Arts in London, as well as the 1972 Award for Outstanding Accomplishment on behalf of the Systems, Man, and Cybernetics Society of I.E.E.E. last June. . . . **Nick Mumford** was appointed Director of the Lance Program at L.T.V. Aerospace's Michigan Division. Nick has almost 25 years of experience with L.T.V., 17 of which have been in supervisory positions within its engineering organizations. Prior to this appointment, Nick was Lance Industrial Engineering Services and Lance Engineering Test Service Test Manager. If your Secretary had been sufficiently adroit, I would have called the foregoing from a Mumford mid-July letter, but no—we had to await a press release! . . . Latest address changes have **Lou Balsam** to Page Communications in Tehran. You and **Art Hall** of Cabot Carbon should get together, Lou. **Chuck Buik**, our old V-12 bugler, from Essex Junction, Vt., to Joy Manufacturing in Pittsburgh. . . . **Jack Atwood** of Allied Chemical appeared hail and hearty when last viewed at Sullivan's Steak House in Rhode Island in mid-August.

The mention of V-12 brings to mind the following U.S.S. Graduate House Regulations Captain Vincent K. Buller, U.S.N.R., forwarded sometime ago. How many of us subscribed or followed these Station Regulations? Absences: no trainee may absent himself from classes, drills, or from his quarters without authority. Muster will be taken at all formations. No one except the Medical Officer can determine whether or not a person in the navy is sick and no trainee is to absent himself from any required class because of illness, or any other cause. The trainee *must* report to the Sick Bay *before* the drill, class, or early morning exercise is scheduled to start, to be excused from same. Bounds of This Station: Trainees are to stay "On Bounds" at all times except when granted special liberty—Wednesday evening liberty, weekend liberty, or leave. The bounds for free gangway are: N.E.—Ames St. to B&M Railroad; N.W.—B&M Tracks to Cottage Farm Bridge on Memorial Dr.; South from Cottage Farm Bridge on Memorial Dr. to Ames St.—Hard to believe!

Bill Shuman just called to advise that as of November 13, the following classmates have shown interest in our Madrid—Torremolinas sojourn scheduled for March 30 through April 8; William McKay, Tom McNamara, Al Bowen, Alvin Cohen, Jack Freiberger, Bill Haff, Spence Standish, Frank Gallagher, Dan Vershbow, Charlie Hart, Bob Gardner, and Tom Markey. If your name is missing, don't fret. You still have time to make the plane. Call or write Bill Shuman immediately. Wm. H. Shuman, 15 Summer St., Milford, N.H. (603) 673-3102.

Oh yes, Happy New Year! Our office is now in the Penthouse at Three Center Plaza, Boston. Please drop in when you are in town.—**C. H. Springer**, Secretary, P.O. Box 288, New Castle, N.H. 03854

46

We must ask again that you please excuse our lack of preparing a column for the December issue of the *Review*. Regretably, one needs material to prepare a column and this material must come from you. Will you please write, especially those of you who have never had any mention in the notes for the past 26 years?

We received a very nice letter from **Jim Craig** responding to an article about him in the Class Notes. Jim reports he was nonplussed by the article and discovered there were things about himself in this article that, if he hadn't read, he wouldn't know. He has written us to tell of his other activities. They are reform politics and law and moderate income housing. On the political side, Jim was active in the campaign of George McGovern, and of candidates for Congress and the State Senate of Massachusetts. On the housing front, Jim is President of the Concord Home Owning Corp., a nonprofit group seeking to build model low and moderate income housing in Concord. Jim reports they now have a test case at the Massachusetts Supreme Court on the legality of some legislation dealing with zoning. Another activity is Jim's directorship of Interfaith Housing, Inc., a group active in lobbying in matters of housing and planning.

In late July, the Craigs met the **Bob Spoerl**'s, the **Bill Jackson**'s and the **Ray Brown**'s in Exeter for, as Jim calls it, a replay of a surprise anniversary party given to the Browns a few weeks earlier by their neighbors. Charlotte and **Bill Schield** called in from Milwaukee and enjoyed a round-robin conversation with the group.

Jim reports the **Ted Heuchlings** and family recently returned from a six-week trip of Greece and Yugoslavia. . . . **Ned Spencer** and his family moved to Wash., D.C., in mid-1971 when Ned accepted an offer to head a sub-department on advanced technology in the Air Transportation Systems Div. of the MITRE Corp. Ned says it has been a stimulating challenge for him to learn the jargon and acronyms used instead of language in Washington. Ned also says Washington has the peculiar property of transforming every technical question into a political one. Ned's son, Don, is now a senior at Stanford working in pre-med courses, and Andy is attending Case Western Reserve. The Spencer's daughter, Laurie, is now 15 and while now in high school, continues with her singing and acting, French horn, and guitar.

Don Burke, from his home in St. Petersburg, Fla., reminisces how he and his wife, Pat, enjoyed meeting everyone at the Reunion in June, 1971. Don's children continue to grow with the oldest son at Stanford, the second son at Brown, the 16-year-old girl in every conceivable Girl Scout activity, and his 12-year-old son active in the Boy Scouts, tennis, and swimming. While Don feels his age occasionally shows when the children defeat him 6-0 at tennis or top him by five strokes at golf, he still feels he is ahead in logic and rhetoric. Don is the Municipal Investment Financial Consultant for Reynolds Securities but fears the role of the cities in controlling their destinies is diminishing.

Felix A. Browder received his degree in Course XVIII at M.I.T. in 1946 and obtained M.A. and Ph.D. degrees at Princeton in 1947 and 1948. Felix taught as an instructor at M.I.T. in 1948 and as an Assistant Professor of Mathematics at Brandeis and Yale between 1955 and 1959. He was Associate Professor and Professor of Mathematics at Yale 1959-1962. During this period, Felix served as Visiting Professor at M.I.T., Cal Tech, Princeton, the Institute de Matematica Pura e Aplicada in Rio de Janeiro, and the University of Sussex in England.

Felix is the author of more than 150 papers and is one of the world's leading authorities in nonlinear functional analysis and its application to nonlinear partial differential equations and integral equations. This work has been recognized with the following honors. Felix has been a Guggenheim Fellow twice, received a National Science Foundation Senior Fellowship in 1958 and a Sloan Foundation Fellow from 1959 to 1963. He was elected a Fellow of the American Academy of Arts and Sciences in 1959. Felix Browder is now Professor and Chairman of the Department of Mathematics at the University of Chicago and has recently been appointed the Louis Block Professor of Mathematics. The Browders and their two sons live in Hyde Park near the University.

Alan Gruber has become President of Triumph American, Inc., a New York holding co., as well as Chairman of the Resolute Insurance Group, the principal operating organization.

We are sorry to report the death of **Colin A. Roberts** on September 6, 1972, at the Rhode Island Hospital in Providence. Colin was Vice President and Secretary of the Allendale Mutual Life Insurance Co. of Providence. Colin was a native of Providence and had lived in Barrington for the past 22 years. He had been active in school board activities, serving for two years as board chairman until 1957. Colin is survived by his wife, Elizabeth, two sons, two daughters and two grandchildren, all of Barrington. . . . We are also saddened to advise you of the death of **James K. Dun** of Naples, Fla., on March 21, 1972. We have no other details.

Until next month, the best of New Year's wishes to you all.—**Russell K. Dostal**, Secretary, 18837 Palm Circle,

H. G. Ingraham, '49. *J. Yamron, '49.*

Cleveland, Oh., 44126

47

It's Friday and for the first time in a long time we are seeing sun in Cleveland, so maybe things are looking up. The mail bag is rather slim so by definition these notes have to be rather brief. First, from the clipping services: **Jim Prigoff** has been appointed Group Chairman of U.S Industries' Apparel and Accessories Group. His sphere of responsibility will be the Jane Colby, Bayles Brothers, and Tiffiny Uniforms divisions. Jim will be staying in New York in the rag business, which I believe is the right phrase. Congratulations and good luck. . . . **Dr. Jordan Baruch** of the Harvard Business School has been named to the Science Information Council, the advisory body to the National Science Foundation's office of Science Information Service. . . . **Dick Knight** has joined the Alumni Association as Associate Secretary which gives our vintage pretty near a monopoly in that group. . . . **Vince Haneman** has been appointed Dean of the School of Engineering at Auburn which means that Vince effectively must have gone home from Boston just in time to pack up and move from Oklahoma to Alabama.

Short notes from the group advise the following: **Walt Kern** has received his eighth patent. This one for an electronic packaging system. . . . Our long-time bachelor, **G. S. Parker**, advises that he is still with I.B.M. World Trade Corp., residing in Suffern, N.Y., and that his children are now 2 and 4 years. . . . **Bob Drye** is in private medical practice in Carmel and lecturing on drug abuse at Stanford. His note points out that it was too far for Reunion—seven kids. It seems that he is trying to tell us something. . . . **John Maxfield** and wife have co-authored their third math text entitled *Keys to Mathematics.*

Beal Marks writes that he is Chairman of the Tioga District Boy Scouts and Treasurer of the Tioga Recreation Assoc. His wife is in the antique business and they have a son and daughter in the University of Syracuse system. . . . **Bernard Morrill** is Chairman of the Department of Engineering at Swarthmore College and has recently authored *Introduction to Equilibrium Thermodynamics.* **Earle Iselin** received his master's in Engineering Management from the University of Dayton and has been promoted to Assistant Professor of Industrial Engineering Technology. . . . Until next month. Drop a line.—**Dick O'Donnell**, Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

48

At the October meeting of the Reunion Committee, discussion and plans centered on publicity, program, regional committees, and the yearbook.

PUBLICITY—The first reunion mailing was the Class President's letter which has been sent. The next mailing was scheduled for November and included an address list of all of the Class of '48. The November mailing also provided a list of classmates planning to attend the Reunion, some outline of the activities, reply card, dues request, estimate of the size of the reunion and changes at M.I.T. since 1948.

Hopefully you have received Christmas cards from a few friends who "found" your address on the address list. Perhaps you would write your friends about your reunion plans. . . . The suggestion was put forth to have our "adopted" '48er, President Weisner, write a note sometime in February or March to "fellow" '48ers regarding M.I.T. and the Reunion.

PROGRAM—The Reunion Committee reviewed the decision to plan a Friday recreational program at an off-campus location suitable for golf, tennis, swimming, and related activities. The decision was to continue Friday, June 1 in the program.

REGIONAL COMMITTEES—The Regional Program is based on dividing the country into 55 areas and inviting an alumnus in each of these areas to contact class mates in his region with news about the Reunion. Letters were sent inviting alumni to be Regional Chairmen. During the spring the Regional Chairmen will be asked to arrange an opportunity for '48ers in the region to gather at an M.I.T.-related function. Geographical separation will be a problem in some regions, but when feasible I hope '48ers can get together to exchange ideas about the Reunion and provide feedback to the Reunion Committee about plans.

YEARBOOK—The Reunion Committee is wrestling with the problem of the cost of producing the yearbook. Some alternative will be selected and a means found to provide biographical information. In addition, a questionnaire will be sent out requesting statistical information. Anyone with a creative technique for reducing the cost of obtaining 1200 biographies and publishing them—please send your suggestion to the Reunion Committee.

John Reid suggested that the Class of '48 invest in jackets—perhaps gray with red trim. **Dick Baker**, who owns and operates companies in the apparel and uniform business, learned of our interest. Dick wrote that if we inform him of the quantity, he would quote a price and make a deal that we can not afford to refuse. Send your order in! . . . When I was in Cleveland in November, I visited **Tom Zsembik** and his wife Doris at their home in Shaker Heights. Tom is Treasurer of Lindsay Wire Weaving Co., in Cleveland. He had been Corporate Controller of Woodall Industries. A few months after he left Woodall, the company was acquired and merged. Tom started in cost accounting after graduation and has remained in the financial side of business. Tom and I were speculating about how many other "engineers" in the Class are now treasurers and controllers. I speculate that there are probably 50 alumni at this level and I expect about 15 of them at the Reunion. Doris is studying Spanish, and recently she and Tom visited Spain. Their son Michael has applied for early admission at the University of Sewanee, Tenn. Tom asked if I had been in touch with **Bill Revoir** or **Louis Rasmussen**. . . . **Harold Field** writes from Minneapolis that he is currently serving as Chairman of the Minnesota Pollution Control Agency. The agency consists of nine members appointed by the Governor for staggered four-year terms. The agency sets policy for a professional staff which enforces pollution control laws.

The 3M Co. announced the promotion of **William T. Wise** to General Manager, Medical Products Div. Bill joined Riker Laboratories in 1961 as Patent Counsel and Assistant Patent Director of Pharmaceuticals for Rexall Drug and Chemical; Riker's parent Co. at that time. Bill later served as Vice Chairman of Rexall's ethical drugs group, and when Riker joined 3M in 1970, he became Vice President and Assistant Secretary of the subsidiary. . . . **Gordon Johnson** has been appointed as one of three new members

P. K. Stein, '49.

of Virginia Governor Linwood Holton's Advisory Board on Industrial Development. The appointments are subject to confirmation by the General Assembly. Gordon is Chief Executive Officer of LogEtronics.—**S. Martin Billett**, Secretary, 16 Greenwood Ave., Barrington, R.I. 02806

49

We have bad news to start out this month's column. **John E. Whitman** of the Hunt Process Co. in Santa Fe Springs, Calif., died on August 30, 1972. I have no other information at this time.

Lacklan F. Blair starts off, "Spending 1972-73 on leave from University of Illinois, where I am Professor of Urban and Regional Planning, as a N.A.S.P.A.A. Public Administration Fellow with the U.S. Environmental Protection Agency." . . . **Harold Proctor** reports that he became President and Treasurer of Gabriel Electronics, Inc., in Scarborough, Maine, upon purchase of the operation from Maremont Corp. . . . **William Birnbaum** reports that he is happily married after 22 years, with a daughter just started at Cornell. He is impressed by "how delightful campus living can be." It's his tenth year at Grumman Aerospace and he is avionic project engineer on A.E.G. Aircraft. . . . **Herb Federhen** and **Ken Prytherch** share a common problem, namely two children in college at the same time. I too am in this delightful (?) situation for this year only. Herb writes, "I now have two children in college: a daughter at William and Mary, and a son who is now a transfer student at M.I.T. It's obvious that I'm not old enough for this sort of foolishness, but there they are. Incidentally, if you start getting requests for contributions from me next year, don't be surprised." Ken says, "With a son at Colgate, Class of '75, and a daughter now at M.I.T., Class of '76, I expect to be in the poor house, hopefully not before '77. Seriously though, to come up with $9,000-plus per year is no laughing matter. It makes one give much thought to the question, 'are these expensive private institutions really that much better than the much lower cost state-supported schools'?" I say, *ouch!*

Robert D. Brown, of Boston, was elected Second Vice President of the American Institute of Planners in October 1972. The A.I.P. is the national professional society of city and regional planners in the United States. Bob is Staff Director of the New England River Basins Commission in Boston. He received a combined B.A. from Middlebury College and B.S. in Civil Engineering from M.I.T. in 1949, and his master's degree in City Planning from M.I.T. in 1951.

Harold G. Ingraham has been appointed Senior Vice President and Chief Actuary of the New England Life Insurance Co. in Boston. Hal is a Fellow of the Society of Actuaries, a member of the Boston Actuary Club, and of the Society of Actuaries Education and Examination Committee. He joined New England Life as Actuary in 1967, became a Vice President in 1968, and Chief Actuary in 1971. He and his wife, Sandra, and three children, are living in Dover, Mass., where he belongs to the Dedham Country and Polo Club and the Mayflower Society.

Paul Weamer reports that he is now sales manager for two companies, one with a very prosaic product, roof ventilators, the other with a very exotic product, one-of-a-kind, made-to-order heat exchangers. . . . A mailing from Response Analysis Corporation, identifies Len Newton, Vice President, as having "an especially strong background in research for financial institutions, utilities, and trade and professional associations. Recent studies include corporate-reputation research for several leading banks and insurance companies, a correspondent banking market study, public attitudes toward utilities, research of housing and urban affairs problems, financial-services behavior, and attitudes of consumers and appraisal of drug companies. Coverage of his speeches appears frequently in the financial trade press." . . . Jack Barriger reports that he has become President of the M.I.T. Club of Chicago for the 1972-73 year.

Professor Ira Dyer, head of the M.I.T. Department of Ocean Engineering, has been appointed a member of the Coast Guard Science Advisory Committee, which provides external advice and expertise in the fields of marine science and technology. . . . Once again, **Harold Rorschach,** Professor of Physics at Rice University, has received a $1,000 George R. Brown Award for superior teaching. Hal has won the award four times before, and he won the $4,000 Excellence Prize in 1968. In addition to his position at Rice, he is a professor of physiology and pediatrics at Baylor College of Medicine. Hal joined Rice in 1952, became a professor in 1961 and chairman of the department in 1966. His teaching award was for courses in beginning electricity and magnetism and mechanics. **Jack L. Baker** reports "Still in executive recruiting—engineering, manufacturing and technical sales—my 36 placements this year included Clark Loman of the Class of 1968. . . ."

Northrop announces that **Joseph Yamron** of Concord has been appointed vice president and manager of the Precision Products Department in Norwood, Mass., a major supplier of inertial sensors and guidance systems to government and industry. Joe is currently teaching a graduate-level business-management seminar at M.I.T. He has been in the aerospace industry for 23 years, including 10 years with United Aircraft Corporation where he was Vice President of Engineering in the Systems Division, and a tour of duty with Sanders Associates as Vice President prior to his recently joining Northrup. . . . **Roberto Galvez-Barnes,** the Honduran Ambassador to the United States, delivered the commencement address this spring at Nathaniel Hawthorne College in Antrim, N.H. . . . Professor **Eugene Skolnikoff** is one of nine scholars the State Department has invited to study its "external research" program which reevaluates world trends for the Secretary of State. . . . Pennsylvania State University announces the awarding of a Ph.D. in meteorology to **Francis Pooler, Jr.,** of Chapel Hill, N.C.

The annual announcement has arrived from **Peter K. Stein,** Arizona State University Professor of Engineering, regarding the Measurement Systems Engineering Short Course to be held in Phoenix, January 29-February 3, 1973. The theme: "How To Obtain Valid Data on Purpose—In 1983." Y'all come. . . . M.I.T. announces the retirement of **Patrick Youtz** of the Division of Sponsored Research, Lincoln Laboratory, after 28 years. I wonder how many others of our classmates have retired at this relatively early date? . . . **Charles L. Storrs** has been elected to the Board of Directors of the American Nuclear Society. He is currently the Director of Projects in the Department of Nuclear Power, Combustion Engineering, Inc.

After an unbelievable spell of bad

weather in early November, there is a beautiful fall day outside my window, as I wish you all a happy and rewarding New Year. Best wishes to all.—**Frank T. Hulswit**, Secretary, 77 Temple Rd., Concord, Mass., 01742

50

Donald J. Eberly reports that he is now the Coordinator for new health and environmental programs at A.C.T.I.O.N., the new Federal Agency that includes the Peace Corps and V.I.S.T.A. . . . **Jack J. Jackson** has been appointed Director, Coordination and Control, in the Casualty and Surety Division's Data Processing Development Department at Aetna Life and Casualty. Jack lives in Glastonbury, Conn. . . . Dr. **Carl F. Long**, Associate Dean and a member of the faculty for 18 years, has been named the eighth Dean of the Thayer School of Engineering, one of the three graduate professional schools associated with Dartmouth College. Dr. Long was the unanimous choice of a broad-based search committee after a four-month review of candidates. He is a consultant for the New Hampshire Water Supply and Pollution Control Commission, and the U.S. Army Material Command. He is the Director of the Dartmouth College Fallout Shelter Advisory Service and has served as the Chairman of the Hanover Town Planning Board for the past five years. He is a member of the American Society for Engineering Education, the American Association for the Advancement of Science, Society of Experimental Stress Analysis, Yale Engineering Association, the American Association of University Professors, and three national honorary societies: Chi Epsilon, Tau Beta Pi, and Sigma Xi. He is listed in *American Men of Science* and *Who's Who in the East* and is a registered professional engineer. Dean Long is married to the former Joanna Tavares of Somerville, Mass., a graduate of the Nursing School of Simmons College, and they have two children, Barbara Anne, 11 and Carl, Jr., 14.—**John T. McKenna, Jr.**, Secretary, 2 Francis Kelly Rd., Bedford, Mass. 01730

51

This is my first opportunity to compile a column for our Class and, I must say, I welcome this particular task. Having a chance to summarize the notes supplied by fellow classmates makes me feel that I have been personally in touch with so many of you.

Marv Burns reports that the R. and D. business, as he views it, has been improving rapidly after a few tough years. To quote him, "My situation has brightened with several large programs from the National Institute of Health for the development of new techniques for contraception and reversible sterilization for both male and female. Isn't it great that engineers can volunteer these ideas and finally be able to work in these areas?" . . . **Charlie Compton** is Chairman of the Science Department at Phillips Exeter Academy and has recently been named a member of the executive board of the American Association of Physics Teachers. . . . **Greg Gentleman** reports from Des Moines, Ia., where he lives with his wife, Julie, and five children. Greg is President of Swanson Gentleman, Inc., manufacturing representatives for a number of firms selling to the building construction market. Greg recently finished up the summer as Commodore of the Des Moines Sailing Club where he races a 470-class sailboat.

Bob Wedan is Director of Systems Development Directorate at the Department of Transportation Technology Systems Center in Cambridge. Like so many others, he has had the opportunity to work on several projects relating to the "quality of life" aspect of our society such as rail technology, tracked air cushion vehicle development, personal rapid transit, highway automation, S.T.O.L. avionics, satellite systems and Air Traffic Control systems. Bob is very active as a pilot and ham radio operator. He is Chairman of the Committee for Air Navigation in the Institute of Navigation and is a member of the Avionics Panel, A.G.A.R.D. . . . From Belle Mead, N.J., **Roger Schonewald** reports that he is Manager of New Products for Ingersoll-Rand Research. He describes his responsibilities as "scooping the plastics industry through product development and marketing." . . . Locally, **Hank Spaulding** of Lexington tells us that Spaulding and Slye Corp., has been active locally and elsewhere in real estate development, particularly in office buildings and condominiums. He is president of the firm and those who drive up and down Route 128 and through downtown Boston have had an opportunity to see examples of his firm's success and activities. Hank and I have the pleasant opportunity of meeting at the local elementary school P.T.A. meetings. He is the proud father of seven children. . . . Two of our classmates are working at Bolt, Beranke and Newman. . . . **Frank Heart** is Director of their Computer Systems Division and **Parker Hirtle** is Department Manager, concerned primarily with consulting in architectural acoustics and noise control. Parker has been with B.B.N. since 1969.

Another product development man is **Larry Hitchens** who is doing his thing at U.S. Steel. Larry's present address is Sewickley, Pa. . . . **Walter Kinzinger** is on the technical staff of MITRE Corp., operating from his home in Potomac, Md. His specific duties involve activities in support of the Joint Chiefs of Staff Master Navigation Plan. . . . **Bill Krampert** is a principal in the management consulting firm of A. T. Kearney and Co. He is active on the M.I.T. Alumni Fund Council in Chicago, and a member of the Education Committee of the Illinois State Chamber of Commerce. . . . Another classmate active in the construction business is **Jon Leffler**, construction director for Rouse-Wates. This firm is engaged in building garden apartments, townhouses, and a group of "system" (concrete panel) buildings in St. Louis using the English Wates System.

Allan Larsen lives in Wakefield, Ma., with his wife, Esther, and 4 children. Al has started his own company, A. L. Larsen Co. Inc., selling graphic arts equipment and supplies throughout New England. He spent the previous 10 years at Raytheon. . . . **Dick Reedy** is also one of our local M.I.T. alumni residing in Melrose. Dick is President of Cordell Engineering, Inc. . . . Finally, a note was recently received announcing the appointment of **George Brown** as director of technologies panels of the Committee on Marine Systems and Technology of the American Institute of Aeronautics and Astronautics. —**Samuel Rubinovitz**, Assistant Secretary, 3 Bowser Rd., Lexington, Mass. 02173; **Fred W. Weitz**, Secretary, 4800 S.W. 74th St., Des Moines, Ia. 50321; **Marshall Alper**, Assistant Secretary, 1130 Coronet Ave., Pasadena, Cal. 91107; **John Dowds**, 1800 N.W. 18th,


W. H. McTigue, '54. *R. Warburton, '57.*

Oklahoma City, Okla. 73106

54

Happy New Year! **William McTigue** is now a partner in Haley and Aldrich, Inc., as well as being Treasurer, Senior Vice-President, and Director of the consulting soil engineering firm. . . . **Len Wimpfheimer** has been named Business Development Manager of Merck's chemical division. . . . **Jerome Catz** is currently Associate Dean of the University of Miami's School of Engineering and Environmental Design. . . . **Bill Eccles** heads up the Department of Computer Science and is teaching elementary circuit analysis at the University of South Carolina. On teaching (for the first time in nine years) Bill says, "What a mind bender!" . . . **Nick Markoff** enjoys living in Evanston, Ill., and traveling the midwest for work.

Fred West presented a paper at the 138th meeting of the American Astronomical Society in August. Based on three years of research, it was titled "Preliminary Orbital Elements of the Spectroscopic Binary in A.D.S. 14893." Fred also attended the International Astronomical Union Colloquium Number twenty-one on Globular Clusters. . . . **Henry Hirsch** asks, "Why did the notes I sent last year fail to appear?" This led to locating several envelopes of clipping data which the Alumni Office sent out in Fall and Winter 71-72. So bear with us for the next few issues. If your material appears and is obsolete, send in an updated version. . . . Backlog items: H. Hirsch is back at the University of Kentucky Med School after sabbatical at Brookhaven National Lab. . . . He reports visiting **Jack Maier** and **Mickey Daniels**. Jack is Plant Manager with the Mine Safety Appliance Co.; Mickey has his own clinical lab in addition to his duties as head of Pathology in a Long Island hospital. . . . **Al Ward** took up sailing in a 10-foot sloop-rigged dingy while **Jim Hazard** was one of 21 who sailed the *Gazela Primerio* from Lisbon, Portugal to Philadelphia. It will be on permanent exhibit at the maritime museum there. Jim is Manager of machinery development at Scott Paper Co.

Fred Rubel is a consulting engineer in private practice in Tucson, developing and designing air pollution and water pollution control processes and equipment. . . . **Charlie Smith** and wife Pat reside in Paoli, Pa., where Charlie is Senior Mechanical Engineer Locomotive for Penn Central R.R. . . . **Tom Bird** is continuing work in planetary exploration at Jet Propulsion Lab. . . . **George Sebestyen** was promoted to Group Vice-President at Sanders Associates Federal Systems Group. . . . **Bill Hartrick** commands an engineering construction battalion. . . . **Arthur Sargent** is Project Officer for Tactical Operational Testing and Evaluation at a Florida Air Force Facility. . . . More backlog along with new material next issue.—**E. David Howes, Jr.**, Secretary, Box 66, Carlisle, Mass. 01741; **Charles Masison**, 76 Spellman Rd., Westwood, Mass. 02090

55

The news from Southfield, Mich., is that **William T. Deibel** has been promoted to General Manager of the Eaton Corp., brake division. . . . After four delightful years as Plant Manager at Shell's rubber and plastics plant near Marietta, Oh., **R. Peter Toohy** has moved to Houston as Manager of Shell's plastics business. This is a new position brought on by Shell's shift to a matrix type of organization for its chemical business. . . . **Russ Meyerand** received a full-page interview in the *Connecticut Business Journal* this fall. The story discussed his position as Director of Research at United Aircraft Corporation's Research Laboratories in East Hartford. Russ supervises 1000 research personnel working on 146 programs. The laboratory is deeply involved in plasma research, and is one of the two facilities funded by the Atomic Energy Commission for work in the field of controlled fusion. Another area of active effort is an advanced gas turbine for efficient power generation. Other U.A.C. scientists are involved with lasers and new battery technology. About half of the lab's work is devoted to federal contract, with the balance sponsored by various divisions of U.A.C. Russ sees his responsibility as split between administration and research. He also spends time with his four-year-old daughter, taking her out on the family's 13-foot Boston Whaler for fishing off his summer place in Rhode Island. Russ is married to the former Mary Grace Guillemin.—**Allan C. Schell**, Secretary, 19 Wedgemere Ave., Winchester, Mass. 01890

56

Frank Bader has become a consultant in managing engineering and manufacturing after leaving his position as Vice President of Operations of Dorne and Margolis. Frank and Mary and their three children live on Long Island. . . . **Bob Follett** works out of I.B.M.'s Public Sector Operations in Bethesda with specific responsibility for servicing the Bureau of Standards. . . . Maybe he'll work with Dr. **Charles Berg**, Deputy Director for Engineering in the Institute for Applied Technology.

The July 9 San Francisco *Sunday Examiner and Chronicle* contained an interesting feature article on **Maris Fravel**'s part in the fight against high-rise buildings on Russian Hill. . . . **Russ Schweickart** has been selected as the pilot of the backup crew on the first mission on the Skylab, the first U.S. earth-orbiting space station. . . . **Hal Wertheimer** co-authored an article in the Bendix Technical Journal last winter on "A Study on Spark-Ignition-Engine Control Variables." This article was an analysis of extensive test results on an automobile engine to determine the optimum set of variable controls for auto exhaust pollution control and economy. . . . **Max Plager** was promoted to Associate Professor of Mathematics at Roosevelt University, Chicago, last spring.—**Bruce B. Bredehoft**, 3 Knollwood Dr., Dover, Mass. 02030; **Mrs. Lloyd Gilson**, 35 Partridge Rd., Lexington, Mass. 02173

57

From **Richard Michelini**, we received this note. "With the purchase of a home near Radcliffe, Ann and I have settled (permanently, I hope) in Cambridge. Now I walk to work at the Smithsonian Astrophysical Observatory where I am heading a project in radio astronomy using very long baseline interferometry." . . . **George Beerli** summarized on the back of an envelope his last 15 years as follows: "After Tech, I spent a number of years abroad gaining industrial experience in Finland and Germany and doing some post graduate studies in Germany. I received my M.B.A. in International Busi-

ness in the spring and taught a course in the summer at a local University." . . . **Detlev Hasselmann** is now with TRW in Redondo Beach in the Civil Systems Division. This division is concerned with non-space work and he is engaged in water pollution studies.

Dick Smith and **Charles Murray** were recently made Fellows in the American College of Physicians. . . . **John Day** passed on the news while attending the Reunion that he and two partners had started a company a few years back called I.P.T. (International Production Technology), which makes production equipment for the electronics industry. . . . **Henry Durivage**, now a Major, is assigned to the Joint Strategic Target Planning Staff at Offutt A.F.B. in Nebraska as a Target Intelligence Officer. . . . **John White** sent us the following brief note: "Currently, I am a student at the University of California, Berkeley. It seems that half of my professors are M.I.T. graduates, more recent than I." . . . **Ralph Warburton**, who was previously Special Assistant for Urban Design for the U.S. Department of Housing in Washington, is now Chairman of the Department of Architecture and Architectural Engineering at the University of Miami in Coral Gables, Fla. He has also been elected a Senior Partner of the firm of Ferendino, Grafton, Spillis and Candela, Architects-Engineers and Planners of Coral Gables.

Bob Palter has been named recipient of the 1972 Robert L. Greenberg Leadership Award of The Jewish Federation Council of Greater Los Angeles. The award is intended to broaden the knowledge and perspective of a future leader in the Jewish Community. In addition to extensive activities with the Jewish Federation, Bob, as we have reported earlier in this column, has been very successful as an agent of National Life Insurance Co. of Vermont. Bob and his wife, Rosalind, have two children, a girl, 5 and a boy, 3. More in four weeks. Please write.—**Frederick L. Morefield**, Secretary, c/o Mobil Oil Caribe Inc., P.O. Box X, Caparra Heights Station, Puerto Rico 00922

59

May I begin by wishing you and yours best wishes for a happy, healthy and prosperous 1973. Now the news.

John Brackett, a systems consultant with Softech Inc., has co-published a recent article for the Honeywell Computer Journal entitled "Automated Engineering Design (A.E.D.) Used for Graphics." John received his Ph.D. in Chemistry from Purdue University in 1963 and his major interest since has been predominantly in the field of design and implementation of graphics-oriented interactive systems. . . . **Will Johnson** reports that he recently joined the department of surgery and surgical research at the Boston Veterans Hospital. . . . **Bob Schumacker** writes: "After 12 years with G.E., I have decided to join forces with a small company and continue my work in computer generation of half-tone pictures at Evans and Sutherland Computer Corp., Salt Lake City. My wife, Carolyn, and I look forward not only to an exciting opportunity but some fine hiking and skiing." . . . And from **George Barnett**: "In April '72, I retired from the practice of law to enter family business. I am now Vice President and General Counsel to Al Barnett and Son, Inc., a marine hardware distributor on Long Island."

Cal Gebhart informs us that he has just completed his first year as Assistant Dean of Students at Illinois Institute of Technology in Chicago. He goes on: "After ten years in the military-industrial complex it is quite a change, but I have found it very rewarding and exciting. This position, together with my work as Educational Counselor for M.I.T., has proven to me that dealing with younger people is very satisfying." . . . **Marty Zimmerman** has been elected Director of the M.I.T. Club of Chicago. . . . **Dave Brahm** has been at the General Electric Co., Aircraft Engine Group (Lynn, Mass.) for 11 years and currently is Manager of TF34 Systems and Performance Analysis Operation. Dave lives in Peabody and Nahant, Mass., with his wife Alba and nine-year-old son David. . . . **Joe Kubis** writes that he's joined K.M.S. Fusion, Inc. in Ann Arbor, Mich. The company is trying to develop nuclear fusion by lasers as a future source of electric power. His work is in nuclear physics and applied mathematics. . . . **Bob McAuliffe** dropped me a cordial note on the back of his contribution envelope: "When is the Class Secretary for '59 going to publish info about 1959 in *Technology Review*. We are the only class that is consistently missing! (I've sent data in several times.)" All applications for the next five-year term as Class Secretary will be most courteously considered, Bob!

Received two nice letters this past month. The first is from **Carl Poedtke** who writes, "I have been associated with Price Waterhouse since early 1966 as a member of the staff of our Chicago office. I was admitted to the partnership July 1, 1972 and have been transferred to our New York office in the Wall Street area. I am engaged in providing management advisory services for our clients.

"I have become associated with the M.I.T. Alumni Center here in New York City. I now reside in Weston, Conn., with my wife Marie-Paule, our daughter Gigi, 8, and our son Carl, III, 3."

The second is a long letter from **Adul Pinsuvana** (37 Soipochaimontri, Paholyothin Rd., Bangkok 9, Thailand) to our Class President **Dick Sampson**, "Your letter for the Alumni Fund did something to me. I have not been a very good contributor for various reasons. Your letter reminded me of a lot of things that happened a long time ago; the time that I was in East Campus putting out the "Vector," our house paper, trying to get East Campus residents to participate in campus projects (and you know how successful that kind of stuff was.) If you'll pass this letter to our Class Secretary, he may use part of the letter to put in our Class news. Since leaving Tech in '59, I was in the Royal Thai Air Force for nine years. During my time in the service I was in Hawaii for three months in '62 and later Arizona State University for two years in 1963-65. After getting my M.Sc. in Mechanical Engineering from A.S.U., I returned to Thailand and remained in the R.T.A.F. until November '68 when I left as Captain. I worked as a researcher for our U.S.-Thai Joint Military Research and Development Center under the Thai Supreme Command for two years.

I joined Air Siam, a privately-owned airline in November 1970. We have had quite a time. Air Siam flew Bangkok-Los Angeles for nine months from March '71 to January '72 when we had to suspend our service. We are now flying only Bangkok-Hong Kong but very soon we shall resume our full route of Bangkok-Hong Kong-Tokyo-Honolulu and L.A. Right now I am Technical Service Manager and acting Public Relations Manager as well. We hope to grow into quite an airline soon."

I will complete the remainder of his letter next month and will also have some interesting tidbits from the recent alumni telethon I participated in with some of our classmates (Dick Sampson, **Chuck Staples**, **Al Bufferd**, **Ron Stone**, and **Jerry Welch**) talking to many of you around the country. So, until next month —take care.—**Art Collias**, Secretary, 61 Highland Rd., Brookline, Mass. 02146

60

In Cincy, the stadium is alive with throngs of fans and I find myself reminiscing about M.I.T. and the Bostonian atmosphere, so hopefully I will keep my thoughts on the task at hand and not permit my mind to go off at random.

The good tales for this issue—belated but sincere congratulations to **Ronald L. Berry**, Chief, Planetary Missions Analysis Branch, N.A.S.A. Manned Spacecraft Center, Houston, on his recent "Lawrence Sperry Award" for his "many outstanding achievements in the field of manned space flight, particularly in lunar mission analysis and design development." . . . Since the fall of 1971, **Ronald Burde**, Jersey City, N.J., has been Project Administrator for a newly developed Model Cities Neighborhood Health Center. Interesting to hear his chief concern was in the human resources component of the project. . . . **Larry Eldridge**, Sports Columnist of *The Christian Science Monitor*, covered the Winter Olympics from Sapporo, Japan, and his article in the September 2 edition entitled "Foreigners Root for Japanese," expressed sentiments about the Japanese people—warm-hearted, anxious to help and make friends with foreigners and sincere in their deeds and beliefs.

The October '71 edition of the Bridgeport Connecticut *Post* reported that **Dr. Joseph I. Goldstein**, Associate Professor of Metallurgy, Lehigh University, would speak on "Metal Particles on the Moon," describing in detail the structure, phase relations, and chemistry of metallic particles separated from Apollo 11, 12, and 14 soils, and slightly review the general findings of the Apollo missions to that date. After securing his Doctor of Science degree from M.I.T., he spent four years at the N.A.S.A. Goddard Space Flight Cen-

R. A. Walsh, '60.

ter conducting research on iron meteorites, and is presently principal investigator for the Apollo lunar program.

Author of *After the Planners,* **Robert Goodman** is currently at work on a research project under a grant from the John Guggenheim Foundation, as an Associate Professor of Architecture at M.I.T. Bob has an active past, including a long involvement in planning with low-income neighborhoods and in organizing architects for social change; founder of Urban Planning Aid, one of the first advocacy planning groups in the U.S., helped organize the Architect's Resistance. He is also an architecture critic for the *Boston Globe*. An excerpt from his latest book *The Soft Cops*, appeared in *Design and Environment*, fall, '71. . . . Election of **Ralph Harris** to the Board of Directors of the American Institute of Architects covers a three-year period from December '71. He is the principal of Ralph Harris and Associates, architects of North Hampton, with a practice extending throughout New England and into Florida.

Roger G. Mark, father of three children, is still involved in biomedical engineering, teaching, and research together with clinical medicine in the Electrical Engineering department at M.I.T. With one-half of his time spent at Boston City Hospital, and additional involvement in The Harvard-M.I.T. Joint Program in Health Sciences and Technology. . . . **Howard C. Meadors, Jr.**, was recently awarded three patents for work in data communications at Bell Telephone Labs, Holmdel, N.J. He also lays claim to a talented wife, Phyllis, who plays flute in the State Orchestra of New Jersey, and a four-year old son, Henry Charles.

The law firm of Morgan, Lewis, and Bockius, members of the bar of Philadelphia, recently announced the admission of **Kenneth R. Myers** to membership in the firm. . . . Former President of Engineering Computer Systems, **Norman C. Napier, III**, has been named Chairman of the Board. . . . In July, '71, **David A. Perry** started his psychiatric residence at Upstate Medical Center in Syracuse, N.Y. Dr. Perry received the Jacob E. Finesinger Prize for excellence in psychiatry when he graduated from the University of Maryland School of Medicine in 1970. . . . **Ronald Rohrer** has joined the software technology firm, Softech Inc., to work on A.E.D.C.A.P., the computerized circuit simulation system. The Cancer computer program for analyzing electronic circuits was developed by Assistant Professor Rohrer and his students during his tenure at the University of California at Berkeley. Starting in 1970, the powerful analytical capabilities of Cancer were adapted to I.B.M. computers, with an interactive framework added. The resulting computer program, designated A.E.D.C.A.P., was subsequently made available to the public by Softech through the new Nationwide Time Sharing Computer Utility. Besides being a co-inventor and professor, Rohrer is author of *Circuit Theory,* co-author of two other books, and consultant to I.B.M.

Bob Stengel, in the midst of his home in the pines, Wayland, Mass., is the leader of the Atmospheric Flight Mechanics and Entry Control Group at M.I.T.'s Draper Lab, where he spends most of his time on guidance and digital flight control for the Space Shuttle. . . . In June '71, Major **Frank A. Tappard** resigned his commission in the army and accepted a position in the Office of Assistant Secretary of Defense for Systems Analysis as an Operations Research Analyst. He is currently living in Wheaton, Md., where he attends Johns Hopkins as a part-time grad student. . . . Dr. **Robert A. Walsh**, of Winchester, Mass., was sworn in as an attorney-at-law by the Massachusetts Supreme Judicial Court for Suffolk County, on November 18. He is married to Angela Barile whom he met as an undergrad while she was attending the Mass. General Hospital School of Nursing. Dr. and Mrs. Walsh have two children.

Sue Schur is working hard as an industrial artist. She received a number of awards at the 1971 National Association of Industrial Artists Exhibition, for brochures done for her clients. She is also listed in the new edition of *Who's Who in Finance and Industry*. . . . I received a very interesting newspaper article about **Gerard Cugini**. He bought an old warehouse on the Boston waterfront and renovated it into a luxurious triplex apartment and offices. This design won him first prize in the S. M. Hexter awards program for the "Interior of the Year." . . . I have a copy of a paper by **Don Hatfield** on "Experiments on Page Size, Program Access Patterns, and Virtual Memory Performance" that he did for the I.B.M. D.P.D. Scientific Center. Let's all hope that he is also still doing the great caricatures that used to appear in *Voo Doo*!

It is with great sadness that we report the death of **Donald Richards** in Sept. 1971. We would like to express our sincere sympathy to his wife Patsy and their five children.

Second time around, happy parent **Ralph A. Cuomo** now has a son, Peter John, born August '71. . . . **Gary L. Gibson** was promoted in December to Manager of Strategic Planning with the General Electric Co., Pittsfield, Mass. . . . **John O. Hartung** is presently Manager of business planning for I.T.T. Ragonier, Inc. . . . **Harold Saper**, Management Scientist with Allied Chemical, lives in Piscatanay, N.J. with his wife Nancy and infant son Jason. . . . **Arthur C. Silverman** became a partner of the New York City law firm of Golenbock and Barell as of the first of the year. . . . **D. Montgomery Wells** is still teaching chemistry at Newton High School and is an avid activist in sports car racing. He has one daughter, Michelle, age four. That's all for this time.—**Ron Koetters**, 1654 Sherman Ave., Cincinnati, Oh. 45212

62

Rudolph H. Gawron has moved his family to Roanoke, Va., from Syracuse, N.Y. The reason for this move being that, since General Electric eliminated the Integrated Circuit Department, he has been transferred to the Drive Systems Product Department in Salem, Va., and is now the Manager of Advanced Materials. . . . After receiving his doctoral degree in mathematics recently at the University of Wyoming, we find **Bernard J. Arbic** returning to his native area, Sault Ste. Marie, Mich. Following a three-year leave of absence, he will resume as an Assistant Professor of Mathematics at Lake Superior State College. Professor Arbic and his wife, Colleen, are the proud parents of two children. . . . Speaking about teaching, **Howard A. Plotkin** received a Ph.D. in Industrial Engineering from Stanford University and then joined the faculty of the University of Houston. Congratulations are in order for Howard, as his second daughter arrived in August. **Richard Queeney** is also the father of two girls, Debbie, 5½, and Kate, 2½. Mr. Queeney also has recently been promoted to Associate Professor of Engi-

J. G. Endriz, '64.

neering Mechanics at Penn State. . . . Keeping leadership in the family, we find **Jeremy R. Goldberg** as the First Vice President of their Synagogue, while his wife, Marcia, is president of her women's group—Hadassah. Jeremy states that it has been a busy year for the family. Eliot and Devra, their two pre-school children, are wonderful, but as he says, very time consuming! He spends his spare time as a home handy man for their 1929 house.

Residing in Brookline, **Stephen C. Root** is kept busy also by his three children, ages 7, 4, and 2. His work at Digital Equipment Corp. is mostly graphics, and as he says, it is not quite chemical engineering, but there are plenty of good problems to solve. . . . **Dr. Eugene Finkin** has taken a new job as the Technical Director of D.S.B. Industries in Detroit, which is an 1100-employee manufacturer of auto parts. Again, congratulations are in order. His wife, Lillian, gave birth to their first child in November. . . . As far as yours truly is concerned, I am still trying to seek solutions to the parking problems faced by all sections of the country. My last traveling experience for the company did mean a trip to Europe, where I spent most of my time in England and Holland—**Gerald L. Katell**, Secretary, 122 North Maple Dr., Beverly Hills, Calif.

64

Joe Boling is working on his M.B.A. at the University of Washington, while his wife Louise is pursuing a degree in nursing. . . . **Edward Casper** is a chemist with Chesebrough-Pond in Trumbull, Conn. . . . **David Dunford** is back from Helsinki, Finland and is now living in Fairfax, Va. After a six-month study course, he will be working as an international economist at the Department of State's Bureau of Economic and Commercial Affairs. . . . **John Endriz** has joined the scientific staff of R.C.A. Laboratories at the David Sarnoff Research Center in Princeton, N.J. Before joining R.C.A., John received his Ph.D. from Stanford and was a guest lecturer in the department of physics at Linkoping University in Sweden. . . . **John Enyedy** has been promoted to District Manager for Tymshare's Dallas district. He was previously a sales representative at the company's California offices. . . . **Bill Euerle** is working for the Foxboro Co., in the field of computer applications for the power industry. His wife Anne gave birth to a boy on August 21 of last year. . . . **John Gilchrist** recently visited Japan, Taiwan, and Hong Kong, finding all three to be "super-nice." . . . **Harvey Greenwald** is a member of the Mathematics faculty at the University of California in Irvine, following his Ph.D. in mathematics at Washington University. . . . **Roberto Levis** was one of Puerto Rico's two-man fencing team at last year's Olympic Games. When not fencing, he is an engineer for the Puerto Rico Cement Co. . . . **Joe Kasper** is working for the Analytic Sciences Corp., in Reading, Mass. His current Coast Guard navigation system project puts him in Hawaii every other month. A second daughter was born last April, and Joe has recently published his fourteenth paper in his field of work.

Howard Kirdendall received his M.B.A. in finance at New York University last June while working for I.B.M. He, his wife Sandy, and their two children are living in New Rochelle. . . . **Margaret MacVicar**, Assistant Professor of Physics at M.I.T., has been appointed to the Associate Program of the Danforth Foundation, along with 176 other faculty members of colleges and universities throughout the U.S. Her professional interests range from single crystal growth of refractory metals to hearing loss and educational reform. . . . **Jay Tenenbaum** is directing research on machine perception for mobile robots and industrial automation at Stanford Research Institute. His wife, Bonnie, has begun her Ph.D. program in education at Stanford, following the birth of their first child last August. . . . **Francis Tuggle** was promoted to Associate Professor of Computer Science and Business Administration at the University of Kansas. . . . I might also note that yours truly was elected last November as Moving Vice President of the Young Lawyers of Memphis, the local Bar Association's organization for all attorneys under the age of 36. I will become President of the group this November.—That's the news, so let me hear from you.—**Ron Gilman**, Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

66

When it rains, it pours! News always comes in large batches, but this time passes all records. On top of the material from the *Review* office, I received three letters, a wedding announcement, and a phone call. Keep it up!

Several classmates have received academic appointments. **Stu Madnick** is now an Assistant Professor in the Sloan School of Management. Although I haven't seen Stu lately, I have heard that he has become an authority in many areas of computer science, particularly virtual memory systems. . . . **Stephen Shao-Chung Cheng** has completed his Ph.D. at Columbia and is now a post-doctoral student there. . . . **Martin Kaliski** is now an Assistant Professor at C.C.N.Y. . . . In Urbana, Ill., **David Chandler** is an Assistant Professor of Chemistry at the University of Illinois. He married Elaine Achles, '67, upon graduation and they now have two children. David received his Ph.D. in Chemistry from Harvard. . . . **Malcolm Wheeler** is an Associate Professor of Law at the University of Kansas.

On the West Coast, **Jim Sweeney** was appointed an Assistant Professor at Stanford in Engineering—Economic Systems. The department deals with analytical techniques for complex socio-economic systems. His specialty is micro-economics, especially the economics of housing markets. . . . **Sandy Sawchuk** completed his Ph.D. in Electrical Engineering at Stanford and is now an Assistant Professor at the University of California. Last year he married the former Mariette Timmins, who is finishing her Ph.D. in English at Stanford. . . . **Terry VanderWerff** recently presented a paper before the American Physical Society. Terry is an Assistant Professor at Colorado State University at Fort Collins. . . . **Terry Walzman** received his Ph.D. in Electrical Engineering from the Polytechnic Institute of Brooklyn in June, 1971. He recently presented a paper at the International Symposium on Information Theory. . . . **Thomas E. Seddon**, after receiving an M.S. at Cornell and teaching physics in public schools of New York State, and private schools in Tennessee, has accepted a position as the Dean of the Upper School (grades 7-12) and head of the science department at St. Stephen's

At a mini-reunion of '67 classmates in St. Louis, we find Greg Wight, John Ebert, Wayne Hawkins, Tim Kjellberg and Al Gammon about to hit the surf.

Episcopal School in Bradenton, Fla. He and Jeanette now have two boys. . . . **John Masters** is in graduate school at Ohio State University. He repairs and makes violins in his spare time.

Robert Liberles graduated in June from The Jewish Theological Seminary and was ordained as a rabbi. He was awarded a fellowship for doctoral studies in modern Jewish history. . . . **Peter Addis** reports that after consulting for four months with Gordon Engineering in Wakefield and working for three months at the Department of Transportation in Cambridge, he now works for National Information Services in Central Square. He further reports that he is the proud owner of a herd (colony?) of gerbils. . . . **William Nelson** and his wife Rachel are expecting their first child in December '72. . . . **Peter Brown** has moved from helicopter performance technology to surface transportation systems. A mockup of their state-of-the-art rapid transit car was shown at TRANSPO '72. . . . **Wayne Stevens** writes, "Penny and I had our second child in June . . . I'm with I.B.M. in Hartford as a systems engineer and soon will be starting volunteer work with the Connecticut Prison Assoc. Penny is active in the League of Women Voters."

Ron Muhlenkamp, Connie, and their four children are enjoying life in Winston-Salem. Ron is a security analyst with Integon Corp., an insurance company, and Connie is quite busy with the children and her work with Avon. Ron invites Tech friends who are in the area to stop and say hello. . . . **Jonathon Hopkins** reports that after graduating from Cornell Medical College, he spent the summer "acting like a fool" until starting this fall as a surgical intern at the New York Hospital. . . . **Bill Moss** was released from active duty in the military and is completing a Ph.D. in applied math at the University of Delaware. . . . **Roland Pittman** and his wife Sue had their first child, a girl, in late August. He is still at the Physiology Department at the University of Virginia and occasionally sees **Bob MacDonald** at the Medical Center.

Bill Schnicke, his wife, and three daughters have just moved into their first house in Berwyn, Penn., a few miles west of Bryn Mawr, where they had lived for the past five years. Bill is doing operations research at Ketron, a growing company, and is also enjoying his responsibilities as Registration Chairman for the National O.R.S.A. Convention this November in Atlantic City. . . . Special help this month came from **Sam Wagstaff**. "Several '66ers got together for a small reunion in Princeton, N.J., during the first week of August. **Rich Brady**, **Chris Egolf**, and Steve Parsek '67, met at my apartment at the Institute for Advanced Study. We played tapes recorded from W.T.B.S. and looked at photos of M.I.T. life. Brady is teaching high school in Wash., D.C., and Chris Egolf is now in law school in Washington. My vacation at the I.A.S. is over now, and I am teaching math at the University of Illinois." . . . More help came from **Bob Marsh** who wrote from Phoenix—"Carole and Bob Marsh have settled back into eternal summer in the Valley of the Sun. He's with General Electric's Utility and Process Automation Products Department in Phoenix, and she's continuing her TV and film career in Arizona and on the coast." Over the past several years, Bob and Carole have lived in Springfield, Vt.; San Francisco; Tempe, Ariz.; and Asheville, N.C.

Next month I will continue with more news about the Class. In one final note, the financial pages of *The Boston Globe* recently carried a feature article on the escapades of M.E. Byrn as an economist on the staff at the First National Bank of Boston. M.E. is the wife of **Bill Byrn**. The closest the article comes to mentioning Bill is to say that M. E. is "pretty, as well as brainy, and *married*." . . . Please note the new address and keep up the good work.—**Tom Jones**, Secretary, 59 Commercial Wharf, Apt. #6, Boston, Mass., 02110

67

John Ebert sent a letter describing an unofficial mini-reunion that took place last May in St. Louis. In attendance were **Wayne Hawkins**, Greenville, Ind.; **Tim Kjellberg**, Phoenix; Tammy and **Greg Wight**, Cincinnati; **John Ebert**, St. Louis; and the hosts Julie and **Al Gammon**. "Quarters were provided in the Gammons' living room, which proved to be even cheaper than Burton House and just as comfortable! We had a picnic on Sunday, featuring Colonel Sanders and a huge portion of Tonga Punch. The highlight of the reunion was a visit by Arnie "Woo Woo" Ginsberg (via record), which brought back memories of the Adventure Car Hop in Saugus and caused a tidal wave of nostalgia during which the picture (*above*) was taken. When held to the light and examined closely the picture reveals a somewhat striking and definitely deliberate resemblance to a Beach Boys album cover."

John also reports that Greg and Tammy have a daughter, Katy, and that Al and Julie have relocated to Akron where Al works for Goodyear. . . . Susan Katcher has sent some news about herself and her hubby, **Murray Katcher**. Murray received his Ph.D. in inorganic chemistry from University of Wisconsin in September; he is now in his second year of medical school. "This past summer we were both in Boulder, Mont., where Murray worked at Boulder River School and Hospital, a state institution for the mentally retarded. We had a great time being out West; our Irish setter Titian especially enjoyed the space and clean sky, which was a real treat compared to city life in Madison." Susan has been teaching in primary grades for the last five years in Madison.

Barbara Desmond Gilchrest has finished an internship at Boston City Hospital and is now doing a one-year medical residency there. Barbara and Byron are still renovating a South End townhouse. . . . **David Schramm** left Cal Tech last June after coaching Cal Tech's wrestling team to its third straight conference title. During the summer he was a visiting fellow at Fred Hoyle's Institute of Theoretical Astronomy at University of Cambridge, England. Dave is now an Assistant Professor in Astronomy and Physics at University of Texas. . . . **Alan Fairaizl** writes: "I have been working for Uncle Sam for the last five years, and I managed to pick up an M.S.E.E. from Johns Hopkins. Having gone berserk, I decided to come back to the 'Tute for the Accelerated Sloan Program; $5600 is too damn much. We will be living in Brighton and would be happy to hear from any of the old crew." . . . On August 27, **Ed Lamon** married Enid Cardozo, a law student at University of Connecticut. He is in his second year of pediatric residency in Hartford. . . . **Harvey Schultz** is alive

and well and living in New York. . . . **Larry Galpin** reports that the major development in his life is his long overdue marriage to Bertie Steen of Wilmington, Del. They welcome any visitors. . . . **Thomas Higgins** recently completed a three and one-half year service in the U.S. Army that included graduation from officer candidate school and assignments in Washington, D.C., and Vietnam.

Bob Landley writes: "My wife got her bachelor's degree and pregnant within days of each other (careful planning), and now I am Robert Landley Sr. We bought some land in the woods around here, and I am going to try to build a house if I can ever get electric power in. I still work for General Electric in Daytona. Business is looking up here. How is the aerospace industry elsewhere?" . . . **Glenn Wanek** is a computer programmer in the Milwaukee school system. . . . For three years, **Paavo Pyykkonen** has been working in Liberia, West Africa, as business manager of a mission. He has also been teaching junior high math and science. His wife, Darlene, teaches and operates a clinic. . . . Stephanie and **Robert Rosenberger** have moved to Chicago where he is working for Wesley-Jessen Co. Robert has received an M.B.A. in marketing from University of Cincinnati. . . . In July, 1971, Dr. **Homer Holland** joined the First National Bank of Chicago. . . . **Al Newhall** is once more a full-time student at the School of Theology at Claremont. He and Kathy have a son Alan. Al is an assistant minister at a local church in California. They had an interesting wedding recently—two very elderly wheel-chair patients at a local convalescent hospital.

Ken Finn writes: "I am continuing work with General Foods, Post Division, as training manager. I am working to develop venture teams and using transactional analysis to bring out individuals' latent abilities to grow." . . . **Steve Powell** has been working on his Ph.D. in electrical engineering at U.S.C. . . . **John Fittz** is continuing his work with Campus Crusade for Christ, along with Russ Bjork, '69, and **Steve Douglass**. John became married in August, 1970. He met his wife Joanie through Campus Crusade. . . . **Susumu Mitarai** studied accounting at N.Y.U. after working for Scott Paper Co., for 18 months. He is now working for an accounting firm. He and Ingrid have their first child. . . . **Alfonso Falco** is working for Boeing in Seattle. . . . **Thomas Hughes** is employed by the Army Corps of Engineers in San Francisco.—**Jim Swanson**, Secretary, 508 Thompson Ave., Mountain View, Calif. 94040

68

Winter is slowly coming to the Washington area as we complete our first full year away from Boston. The winters here are more pleasant than in Boston because it never gets as cold, but this is compensated for by the fact that the summer is unbearably hot and humid. I have seen many members of the Class recently, due to travels and other events. While in San Francisco, I visited **Gary** and **Carolyn Bjorklund** in Palo Alto. Carolyn is working on the development of sensors for paper process control while Gary is working for a doctorate in lasers at Stanford. . . . I also spoke to **Roy Shapiro** there who is in the Electrical Engineering department at Stanford. . . . Back at home, we went to a party recently at **Walt Morrey**'s apartment in Alexandria. Walt is in the navy and is doing programming at the Center for Naval Analysis in Arlington. At the same party was **Bill Ryder**, who is working as an electrical engineer at Ft. Meade and plans to be moving to Columbia, Md., in the near future. . . . Finally, we bumped into **Steve Reimers** recently at a Young M.I.T. Alumni Club of Washington meeting. Steve is finishing a navy tour.

From the notes we have received in the mail, we are happy to see that the news from the military is decreasing, and the news of people finishing up their graduate work is increasing. We also have one item to report this month which we picked up entirely accidentally—our "sports report." While thumbing through a sailing magazine, we noticed an article which reported that **Alix Smullin** was part of a team from the Swampscott Dinghy Club that won the Mrs. Charles Francis Adams Trophy for the North American Women's Sailing Championship, held in Cleveland this past August.

A lot of news this month from Hill Air Force Base, Utah. Captain **Gary Johnson** is a Minuteman missile test engineer there, and in his spare time serves as the cubmaster for the base Cub Scout pack. . . . Captain **Stephen Richards** is a T-39 pilot now, serving with the 2849th Air Base Group there. A news release from the Air Force indicates that he has recently been awarded the Vietnamese Cross of Gallantry by the Republic of Vietnam for his outstanding service to the Vietnamese Armed Forces while assigned to Phu Cat Air Base in Vietnam.

As we mentioned, in the department of education, we have reports of some people getting out, but there are also some going back in. Among the former is **Eric Weitz** who recently received his Ph.D. in Chemistry from Columbia University and has begun postdoctoral work in the chemistry department at Berkeley. . . . **Robert Loveless** and **Barry Mitnick** are also expected to be joining the growing ranks of graduates shortly. Robert is presently at Cornell, studying physics, and predicting that he will be part of the Ph.D. glut by June. He is currently analyzing his thesis experiment on deep-inelastic, coincidence electroproduction. Barry is now at the University of Pennsylvania and expects to finish up by September. He passed his prelims last summer ("the big hurdle"), then spent his time working, and travelling in Maine and England. He is now a teaching assistant in urban politics and is working on his dissertation.

Steven Gamer is also doing graduate work, but he gives no indication whether the end is nigh. He is on a fellowship at Rutgers, doing work in mathematics. His wife, Suzanne, teaches at a school in Middlesex County. . . . **Ken Theriault** is just going back to school after "finally" finishing three years of sea duty in the navy. He is returning to the Institute to do work in Course VI, and reports that he may finish before he reaches the magic age of 30. . . . Another back-to-schooler is **Don Zimmerman**, who began a six-year, joint M.D.-Ph.D. curriculum this year at the Washington University School of Medicine.

Finally, we have some notes from the working class, although they seem to be somewhat of a minority. **David Ellis** has reported his July 23 marriage to the former Susan Gottenberg (Cornell '70). After a three-week honeymoon in Hawaii and California, they settled down in Lynbrook, Long Island. David is working for a law firm in mid-town Manhattan, while Sue teaches at a Community College on Long Island. . . . **Paul Ware** writes that he is married to the former Carol Katz. He is living in Stoughton, and is working as a Quality Control Engineer under Bill Noz ('57) at the Polaroid Film Division in Waltham. . . . **Peter Jax** is still working at McDonnell Douglas on the DC-10, even though he no longer needs the deferment. In his spare time, he is working slowly towards an M.B.A. at U.C.L.A., and managing apartment buildings. He also was recently engaged to Vicki Pelusi, whom he met in Southern California, so he feels confident in saying that the climate there has been good for him. . . . **Peter Groot** is also in California, by way of a transfer from Binghamton, where he is working as a systems programmer "for the best microfilm plotter/printer on the market." He reports that he is still doing well at table tennis and has been collecting a few trophies.

For those of you who try to figure out which of us is responsible for each column, let me warn you that we switched in midstream this time. Sorry about that!—**Gail** and **Mike Marcus**, Co-Secretaries, 2207 Reddfield Dr., Falls Church, Va. 22043

69

Thomas M. Dooley has completed the operations research system analysis for executives course at the U.S. Army Logistics Management Center, Ft. Lee, Va. Tom entered the army in July 1969 and is now commissioned as a captain. He and his wife Anne live in Aberdeen, Mo. . . . **Carl M. Abramson** now lives in Lake Forest, Ill., where he is employed by the Brunswick Corp. as a sales administrator. . . . Among the five graduate instructors in the department of electrical engineering at M.I.T. who received Supervised Investor's Services, Inc. awards for excellence in teaching was **Norman D. Punsky.** The awards, cash prizes given to graduate students on the teaching staff of electrical engineering, honor those who have demonstrated an interest and proficiency in the field of teaching and to help defray the expenses of graduate study for advanced degrees. . . . U.S. Air Force First Lieutenant **Robert E. Anderson** is now stationed at Thule Air Base, Greenland. Bob, a space surveillance officer, is assigned to a unit of the Aerospace Defense Command which protects the U.S. against hostile aircraft and missiles. . . . **Alan R. Millner** has been commissioned a second

lieutenant in the U.S. Army.

—**Richard J. Moen**, Secretary-Treasurer, 179 N. McKnight Rd., Apt. 318, Saint Paul, Minn. 55119

70

Bloomington is a quiet little college community. My wife, Penelope, and I are endeavoring to enjoy its unique benefits, but certainly miss New England and Boston. Law school continues to monopolize most of my energy and interest.

Larry Azevedo writes that he is pursuing his doctorate in solid state physics at U.C.L.A., after receiving a master's degree last spring. Evidently, Larry has become a bicycle "nut," which he claims is the best transportation around. Also at U.C.L.A. is **Tony Rufolo**, who is working on a Ph.D. in economics after securing his master's. Tony is looking forward to returning to New England after finishing. . . . **Michael Hoffman** has passed all his exams in math at Berkeley, but remains to write his thesis. Michael is hoping that his third year will be swamped with exciting new activities. Class Executive Officer, **Gregory Arenson**, is also pursuing his J.D., but at the neighboring midwestern law school of the University of Chicago. . . . **Karen Wattel Arenson** is employed as an Associate Director of the National Affiliation of Concerned Business Students and is waiting for a good opportunity in journalism.

John Wong, after getting married on Valentine's Day, is working in the office of Planning and Institutional Research at Portland State University where his wife is also a student. . . . **Mary Thornton** is working for the Associated Press in Boston. . . . The Coast Guard is leading the fight against pollution, according to **Dan Cherry**. He writes that he has only about 400 days left cleaning up oil spills. . . . The Planetary Science studies at CalTech of **Joel Mosher** were put aside for a job with the Jet Propulsion Lab, working on the Mariner Venus-Mercury TV experiment. However, the N.A.S.A. cutbacks forced Joel to find employment with N.A.S.A.'s Ames Research Center in Mountain View, Calif., studying the Airborn Science Office's management procedures as they apply to the space shuttle.

Susan Winard writes from Washington, D.C., that she is also in her third year of medical school, working part-time as a research assistant in Obstetrics/Gynecology, and is a member of Students for McGovern and N.O.W. During her first year, she received a U.S. Public Health traineeship, and worked as an interviewer for the Community Alcoholism Studies Program. The topic was "The Female Alcoholic." She says that "Every single patient interviewed felt discriminated against because of sex." The following summer, she worked as a physiologist in the immunology division of the National Cancer Institute in Bethesda, Md., investigating the effects of the oral contraceptive steroids on lymphocyte transformation. Since those at the top of the medical school class are asked to help those at the other end, Sue was tutoring students last summer. As part of this program, she has also been awarded, on the basis of academic performance, a tuition scholarship and partial living expenses. She had more or less decided to specialize in Obstetrics and Gynecology, but after taking an elective in Cardiology and a preceptorship in Surgery, both of which she really enjoyed, she's decided to wait before making a final decision. Sue's daughter, who is 3, is enrolled in a full-day nursery school and has tentatively decided on a career: doctor, chemist, and President.

A couple of short takes: **Louis Zarfas** is working as a design patent examiner for the U.S. Patent Office in Arlington, Va. . . . Last February, **Chuck Lieberman** became engaged to Anne E. Rosenberg (Bryn Mawr, '70), a native of Cincinatti, and planned to be married in last August. Chuck has been at the University of Pennsylvania, where he passed his preliminary doctoral exams last year and took an "along-the-way" master's. He was appointed an instructor in economics last year, and reappointed for this year. He gets "a real kick out of teaching; it is especially satisfying when I see the 'gleam of understanding' in their eyes." Chuck spent the summer doing economic research at the Federal Reserve Bank in Washington, while trying to get ideas for the dissertation he'll soon have to write. Thank you, Chuck, for the kind words about this column.

This month's mailbag is finally emptied with a note from **Howie Bluestein,** who writes, "I suppose that it's about time I sent along a note about myself for *Technology Review!* I would hope that some other people of whom I have heard nothing will see this note and send in something about their activities." In June, Howie received two master's degrees, in Meteorology and Electrical Engineering, from M.I.T., and is continuing in the Meteorology Department in pursuit of a Ph.D. He divided his time during the summer of '71 between a trip to Europe and a stay at the National Hurricane Research Laboratory in Miami, where, among other things, he went cloud seeding. He returned to N.H.R.L. last summer, hoping to fly into some hurricanes "and catch some more big winds at the political conventions." Howie's meteorological interests are primarily tropical disturbances and mesoscale storm structures.

I wanted to make special notice available to the readers concerning **William Behrens'** recent article, "The Dynamics of Natural Resource Utilization" in *Simulation.* Bill is working on his doctorate at the Sloan School at M.I.T. . . . **John Holding** came to Bloomington for a weekend visit. He is still working for the corporate headquarters of Eastern Gas and Fuel Associates in Boston, but is involved in a special project for their Cincinnati subsidiary.

We hope that some correspondence arrives soon so that a greater coverage of classmates can be published.—**Robert Vegeler**, 800 N. Smith Rd., Apt. 7W, Bloomington, Ind. 47401; **Laura Malin**, 406 Beacon St., Apt 1, Boston, Ma. 02115.

71

In November we went shopping for curtains and came home with Pooh, a Saint Bernard puppy, instead. It's a real madhouse with Pooh, Sally Smudge, our deaf, white, short-haired cat with two different colored eyes and thumbs on her front paws, and Rembrandt, Sally's son, a long-haired grey cat that acts like a dog (retrieves and all) and thinks he's a person.

Marc Covitt is alive and well and living near Hartford, Conn. He is a senior systems representative for Sanitas Service Corp., and will be travelling the country installing an automated accounting system. . . . **Howard B. Bluestein** spent the summer in Miami at National Hurricane Research Lab, where he flew into tropical storm "Dawn." . . . **William Dix** wrote, "in a graduate program in Urban Affairs and Policy Analysis at the New School for Social Research, in New York City. I visited **Paul Sullivan** in San Jose, who now has two (yes, *two*) daughters! . . . **Travis Jackson** is at Baylor Medical School, and is trailing, with only one daughter." . . . We got a letter from **Frank Taylor** saying "I have taken a job at Princeton University as a laboratory assistant in Biochemical Science doing research with a group of postdoctoral fellows under Dr. Charles Gilvarg. Employment is a refreshing change from the year I spent wading through applications and writing resumés. The academic environment, as many will agree, is a most desirable retreat from the rest of the insane world."

Keith E. Price wrote, "Am continuing to use the skills learned at M.I.T. and am enjoying my work in the western Pennsylvania coal mines." . . . **Gregory L. Ream** wrote "I am now a grad student in the E. E. department at the University of Colorado, Boulder. I'm pursuing a biomedical program and should get my M.S.E.E. this August 1972. Meanwhile, my wife and I are enjoying the warm, sunny Colorado weather and the mountains."

Nancy Greene wrote, "Just got back from a year in London. I've now got an M.S. in Econometrics and Mathematical Economics from the London School of Economics. I'll be entering the Ph.D. program in economics at Yale next September. The British sense of humour isn't subtle; it's non-existent. I did hear one anecdote, however, worth repeating: They taught two computers to play chess, and wired them together. First Computer: P-Q4; Second Computer: Resign.

Lee J. Scheffler is completing his master's thesis at M.I.T. on the performance of disk subsystems. He's a referee for 1972 A.C.M. Student Paper competition and was in charge of E.E. Department subject evaluation committee for Spring 1972. . . . **Harold H. Nussbaum** just got a job as a case worker with the Idaho welfare agency. He played slowpitch softball this summer under the alias of "Weird Harold" à la Bill Cosby. He won the first athletic trophy of his life. **Dan Griffin** says: "I would like to have Marc Barman rescind his comment about me in the July/August issue. Also I am currently in Denver, Colo., looking for a

job, having received an M.S. in Electrical Engineering from U.C. Berkeley." . . . **Henry C. Stern** is currently in his second year of study toward an M.S. in industrial administration at Carnegie-Mellon University.

Glenn A. Handler has enrolled in the first year class at Washington University School of Medicine. He is among 120 accepted from more than 5000 applicants. He received an M.S. degree in 1972 from the University of Michigan, Ann Arbor. Upon completion of the required four-year curriculum, he will receive the Doctor of Medicine degree. . . . **Louise Grochow** wrote to tell us that she "survived first year at B.U. Medical School—will probably still be here next year (i.e. this year). Bumming off Jerry, '68, this summer while he works on his thesis." **William R. Barber** married Christine Grant on August 12 in Toronto. . . . **Marc Roddin** wrote, "I have always been interested in all forms of transportation, particularly urban and over the last couple of years I have been able to implement my skills in an area in which a great deal of effort is sorely needed. Thus I have been a student at the Transportation Center at Northwestern University. This summer I had a unique chance to put some of what I have learned into some real-world problems, and at the same time get paid to write my master's thesis at the Transportation Research Department of General Motors Research Laboratories. I'm trying to find some sort of behavioral and functional relationship between people's trip-making activities and the opportunities available to them."

Terry K. Kellerman wrote, "Receiving master's in physics this July at Berkeley. Drifting towards computer systems and analysis. Looking for a job (natch!). Anybody know of any openings?" (Read on for encouragement, Terry.) . . . **Andrew H. Sims** is "currently working in Boston for R. G. Vanderweil Engineers as a project manager, specializing in hospital design, doing a couple of ice rinks when things slack off a little." . . . **Mike Pustejovsky** is studying Aeronautics in graduate school at M.I.T. . . . **Hutch Neilson** married Linda Ruth Roy (Simmons '72) on June 10, 1972.

Ah-Poh Yao wins the long distance award—he wrote to us from Singapore. He said, "I am having a great time here in Singapore, it's summer all year 'round here! I am employed as a Mobil Oil manufacturing planning analyst. Just completed a service station computer program for them, supposed to forecast volume scales of gasoline, realizations, etc. The director of Mobil Oil, Singapore, is Dorsi Dunn ('61). I really miss Cambridge a lot—plan to take my leave to Boston June of next year (1973). Girls here are great—they are liberated and beautiful!"

Tommer Pipal sent in a summary of his first year's activities at Northwestern: "1. Project Manager for 120 people working on a six-month, comprehensive, urban medical design project. Results will be presented in Washington during mid-August. 2. Elected President of the Ph.D. Association for 1972-1973. 3. Bought a six by seven foot water bed. 4. I.M. basketball won grad league championship." . . . **Malcolm Casadaban** wrote *Finding Mutants*. . . . **Sally Harvey** informed us that she "started May 1, 1971, as Sanitary Engineer at the U.S. Environmental Protection Agency's Boston (Region I) office, in the Facilities Grants section of the Air and Water Programs Office."

We still need people to work on setting up the Kent State Memorial Lectures. Please contact us. And please write to let us know what you're doing.—**Howard Jay Siegel** and **Leah Jamieson Siegel**, Class Officers, 228C Harrison St., Princeton, N.J. 08540

72

Now that the New Year is upon us, I hope that you all had a good holiday season. Those of you who are offended by the appearance of Christmas decorations before Thanksgiving will please note that the above greetings are actually extended in mid-November.

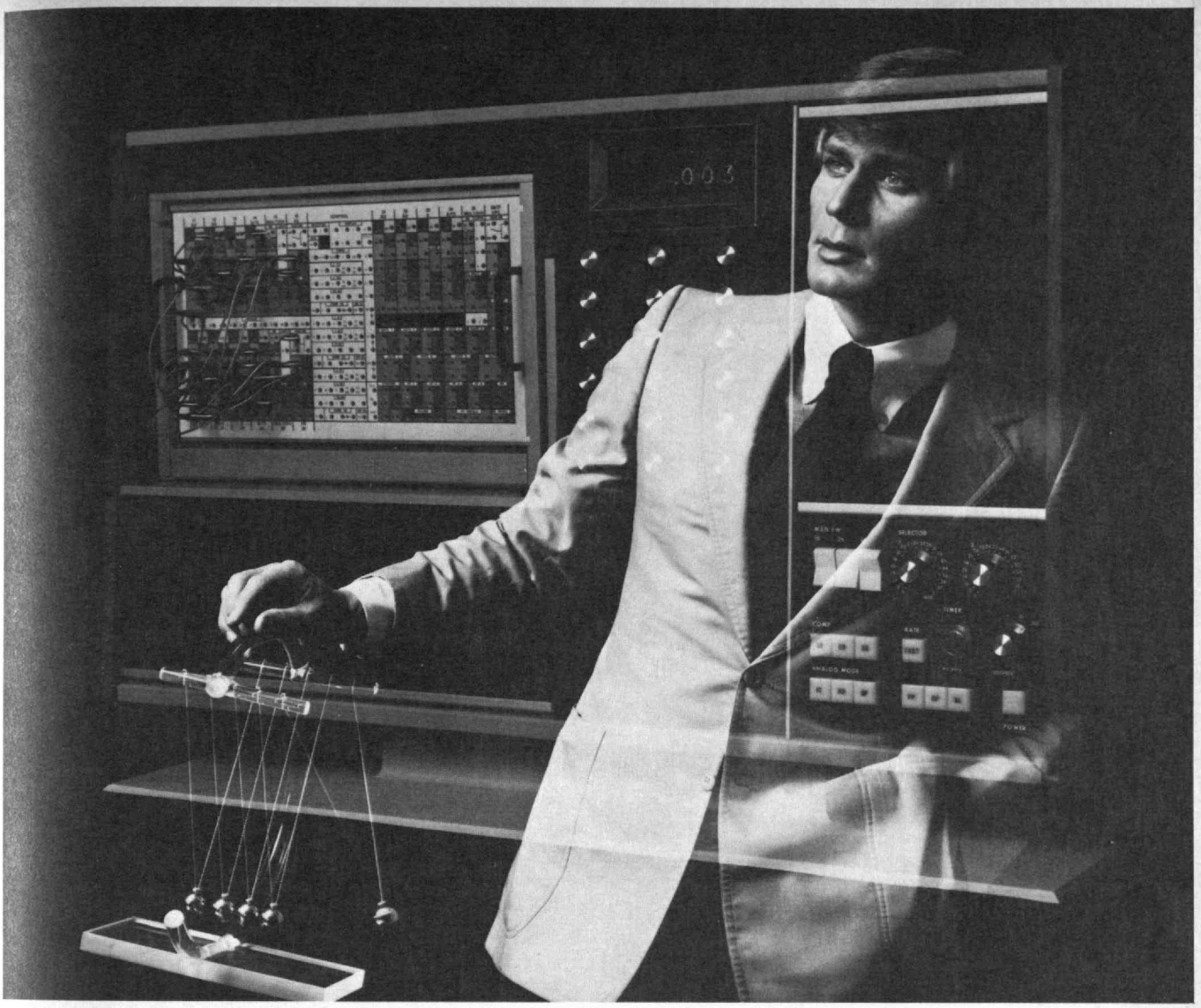
Most news of our Class comes from those in grad school. Still at the Institute is **John Whealler**, recipient of the Schlumberger Fellowship. He is a student in Electrical Engineering. . . . **Nathaniel Mass** writes that he is a Ph.D. candidate at Sloan and a Research Assistant in the systems dynamics group. . . . **Herb Newborn** is doing graduate work in Course III and is a member of the Ashdown Executive Committee. Herb is no stranger to Ashdown, having served on the desk staff for quite a while now.

Stan Zietz informs me that I mislocated him a couple of columns ago. He is really at Berkeley doing graduate work in math. Sorry about that. . . . **Eugene Butcher** and **Bruce Frank** have both started work at the Washington University School of Medicine in St. Louis. . . . **Allen Kirkpatrick** writes, "I'm now married, have one cat, and am a graduate student in the applied science program at William and Mary." . . . **Chuck Ward** spent the summer working in the Wyoming Air Quality Section. He and his wife are in Davis, Calif., where he is pursuing a master's in Environmental Engineering at the University of California.

I got a delightful letter from **Brad Billetdeaux**, of late, Sports Editor of *The Tech*. "Monday of graduation week, I married the former Susan Hollinger, Wellesley, '72. Another fine example of how the Wellesley exchange program helps the Tech tool. We honeymooned in Manhattan, while also looking for an apartment. Both were successful, and we are now ensconced in midtown, with a view of the Empire State Building. I am employed by Caltex Petroleum, one of the major international oil firms. I have found working on Madison Ave. a welcome and challenging change from heat transfer and organic chem classes! My activities are in the process engineering department, where I am working on feasibility studies for various overseas refineries."

I also heard from the best man at Brad's wedding, **Rick Henning**. "I am now a first-year law student here at the University of Virginia. Nestled in the shadow of the Blue Ridge Mountains, it is a travel agent's delight, but it is a far cry from Cambridge in terms of places to go. The cynicism developed up North prevents me from feeling at home as a "Wahoo"—the local school nickname. Have met two other members of the Class here. . . . **Bob Mayer** is a fellow first-year law student. . . . I have also seen **Bob Bray**, who is in the graduate school of English here. I suppose we are a rather unlikely set of M.I.T. alumni, two future lawyers and an English major! We have found that there is a worse place to eat than commons—Newcomb Hall Cafeteria." . . . Rick also informs me that **Rich Levin** is in Yale Law School.

In other news, **Steve Tavan** writes that he is a Marine Chemist for Scripps Institute of Oceanography and expects to spend most of the next year in the North Pacific and South Atlantic. . . . **Warren Lippitt** begins a six-month stint at Bettis Atomic Power Lab in Pittsburgh later this month. . . . As the advertisements say, the new army has joined **Mark Aquino**, for four years.—**Dick Fletcher**, Secretary, 135 West St., Braintree, Mass. 02184



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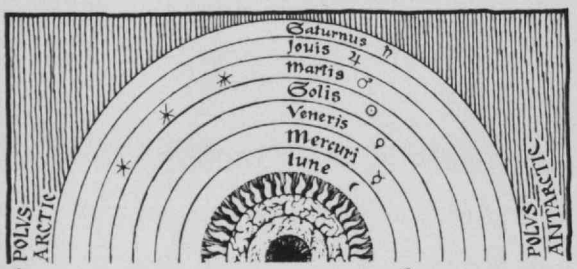
Conversation Pieces

Technically intriguing items from TRW, guaranteed to add luster to your conversation and amaze your friends.

How the Days Got Their Names — On Thursday, March 2, our Pioneer 10 spacecraft left for Jupiter, the first of the outermost planets. Although Pioneer travels so fast it swept past the Moon's orbit in a mere 11 hours, the voyage to distant Jupiter (a half a billion miles away) will take two years.

Pioneer 10's departure took place on a peculiarly appropriate day. Thursday, it happens, is named after Jupiter. In fact, it we look back through astronomical history, we find that every day of the week is associated with an object in our solar system.

Early astronomers named the planets after gods and goddesses, and believed that each planet "ruled" or had primary influence on one day of the week. Jupiter, they held, ruled Thursday and so named the day Jove's day, or *jeudi* in the French*. Our Anglo-Saxon forebears replaced the Roman Jove with their equivalent deity, Thor. Hence we know it as Thor's day or Thursday.



THE NAMES OF THE DAYS COME FROM THE PTOLOMEIC SYSTEM.

Here, for your information, is the complete planetary week. Woman's lib advocates will be pleased to note that we should thank a goddess it's Friday.

Day	*Ruling Planet/ Divinity*	*Anglo-Saxon Equivalent*
Monday	Moon	—
Tuesday	Mars	Tiw
Wednesday	Mercury	Woden
Thursday	Jupiter	Thor
Friday	Venus	Freya
Saturday	Saturn	—
Sunday	Sun	—

*Those of you familiar with the French will see the planet's names clearly in *lundi, mardi, mercredi, jeudi, vendredi,* and *samedi.*

Burn Coal (But Not Throats)! Must a high standard of living and low quality of life always go hand-in-hand? The argument for the case is as follows. A high standard of living requires the consumption of large amounts of energy (e.g., lights, air conditioners, cars, home appliances). In producing and using this energy, however, we pollute our environment. If the air you breathe is toxic or the water you drink causes you to retch, be happy; your discomfort is proof positive you have a high standard of living.

To add to this dilemma, our so-called clean sources of energy are dwindling fast. A logical replacement is coal, the Earth's most abundant fossil fuel. Yet coal is a major polluter. When burned, it produces sulfur dioxide, a gas noxious to lungs, eyes, and throats. In 1970, for example, the U.S. pumped around 28 million tons of sulfur dioxide into the air.

How can we burn the coal and make the electricity and light the lights and run the air conditioners without befouling our atmosphere? At TRW, our answer is to remove the sulfur from the coal ***before*** burning it. The result: clean coal and a clean environment.

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